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The British Association Meeting. THE recent meeting of the British Association for the Advancement of Science was not as successful as usual in the number and character of the papers relating to the electrical and mechanical science. The most important papers on electrical subjects are those of Lord Kelvin on the piezo-electric property of quartz and on a piezo-electric pile, as they definitely add to electrical science a new branch based upon the generation of electricity through mechanical stress. The presidential address of Mr. Glozebrook deals with the ether as a medium for the transmission of vibrations, and light, radiant heat and electrical and magnetic wave propagations are discussed and corelated. The paper of Mr. A. T. Snell on the utilization of water power is mainly descriptive of plants that have already been described in our columns. Mr. Beaumont's paper on variable speed gearing is interesting from a practical point of view, although whether the complication introduced would not outweigh the advantage is a matter that will have to be settled by actual practice before an opinion can be hazarded as to its real value. The paper by Mr. Kapp on the relative cost of copper in different alternating current systems is referred to elsewhere. Abstracts of the above papers will be found in the Digest.

Relative Cost of Copper in Alternating Systems. A PAPER by Mr. Gisbert Kapp read before the British Association for the Advancement of Science, on the relative cost of conductors in different alternating current systems, is likely to mislead in the absence of the necessary qualification. If we had reached a definite point beyond which we could not increase the E. M. F. on account of having attained the limit of insulation resistance, then the results deduced by Mr. Kapp would apply. As it is, however, there was no practical difficulty in the use of 16,000 volts in the Frankfort-Lauffen transmission plant as far as concerns insulation. It makes little difference practically if the insulation stress for the same voltage is much greater in the two-phase system than in the three-phase, or greater in both than in the simple alternating system, if the commercial limit of stress has not yet been reached. It is certainly not to be expected that the advantage from the saving of wire in three-wire multiphase systems will be sacrificed to considerations of insulation stress that practically, at present, have little more than a theoretical bearing. While the paper, therefore, may have an application in the future, it does not establish under present conditions the inferior economy in copper of the two-phase or three-phase systems over the simple alternating system.

Dynamo and Motor Efficiency Tests. THE description in another column of a method for determining the efficiency of continuous current motors and dynamos will be found interesting from the clear and connected manner in which the subject is treated, as well as useful in a practical sense, being based upon actual commercial testing room practice. The rating of dynamos and motors is too often based upon their electrical efficiency—that is, only the watts delivered or received and the armature and field $C^2 R$ losses being included. If these elements alone are considered, the armature speed does not enter into the efficiency, while we now know that the loss from eddy currents increases with the square of the speed, and that from hysteresis directly with the speed. In an actual example given, it is shown that the $C^2 R$ losses are only 975 watts, while the hysteresis, eddy currents and friction losses amount to no less than 2,362 watts, all of which were formerly, and sometimes are even yet, neglected. The real commercial efficiency of the dynamo tested was found to be 90.7 per cent., while its efficiency, neglecting the losses referred to, would be 97 per cent. In designing of any kind it is very advantageous to separate the various elements, not only to determine the various effects, but to enable changes with a view to improvement in efficiency to be intelligently made. The method described by Mr. Cox enables this to be done with the appliances found in all factory testing rooms, and at the same time assists the student to form a clear conception of important points in the theory of dynamo and motor design.

Not Entirely a Personal Litigation. WE continue this week to keep company, editorially speaking, with Mr. Martin and his lawsuit, following it faithfully through all its devious ways and windings. There are three reasons why we are doing this. First, we say it frankly, to vindicate ourselves from slander—always disguised and sometimes so in bogus reports of legal proceedings—published in a journal which to-day is not publishing, we are happy to say, such reports, either with or without—but especially without—"details of personal litigation, because it knows that its readers and patrons prefer other topics." We know this, too, and perhaps we have just vanity enough to believe that by the publication of details, very full and fair, we have cured that journal of at least one bad habit for all time to come. Secondly, because we believe that we are enlightening our readers, while we are not at all entrenching upon, but are adding to, the space which is due them. And thirdly, because we believe that in the interest of honest journalism we are exposing a lawsuit which was in the beginning a sham, and which, from the beginning to the end, was carried on under the false pretense we have clearly shown. In our contribution of this week of the details of Mr. Martin's aims and ambitions, we furnish some facts which, it might be said, go to show that he was not solely the author of that elaborate scheme, though we do not wish at all to detract from the credit due him for the part he played as the figurehead therein; and that he would not have been, at least indirectly, the exclusive beneficiary from success, had such always rewarded his exertions. In other words it may perhaps now be taken as established that this litigation was not entirely a personal affair between Mr. Martin and THE ELECTRICAL WORLD, at least on Mr. Martin's side of the contest. While we always suspected what was Mr. Martin's motive in his strenuous fight for his mandamus, carried on courageously after Mr. Wetzler was defeated, we never were prepared to say what the entire motive was until it was made pretty plain by uncontradicted testimony in this case, the details of which our report has reached to-day. We have heretofore pointed out that Mr. Martin, at the time he commenced this mandamus business, might have foreseen how a glance now and then at our subscription lists and advertiser's contracts would be of benefit to him in his then new enterprise, and while ostensibly securing this, as Mr. Martin is an adept in the art of doing, he was leading the courts to believe that he desired to obtain only such knowledge generally as would enable him to be advised as to the value of his stock. But by to-day's report we see that our surmises were not entirely without foundation, as it shows that the representative of the *Electrical Engineer* was using in Chicago, and presumably elsewhere, the information, or pretended information, which Mr. Martin was thus securing in New York from his examination of the books and papers of THE ELECTRICAL WORLD, and stating while he was doing so "that he had had access to the contracts, subscriptions, etc., and that in making this statement to the Western advertisers he indicated that he had this knowledge on hand and was thoroughly posted on the subject." From all this it appears that at this time two members of the editorial staff (as Mr. Wetzler is entitled to some credit for his efforts, though unsuccessful) and one member of the business staff of the *Electrical Engineer* were actually engaged in an enterprise, as disclosed by the details of this purely personal litigation, to turn whatever gains might arise from occasional slight successes met therein into channels which were not exclusively personal to themselves. While we are afraid that the necessity which gave rise to and the circumstances surrounding this job shall always preclude the *Electrical Engineer* from ever undertaking so hopeless a task as defending the individual members of its business and editorial staff who were engaged in it, we are not entirely without hope—in view of reformations already brought about—that it shall some day be prompted to disclaim all journalistic approval of the character and purposes of such methods. But these odd and heretofore hidden things are not the only points of interest the details contained in our report disclose to-day. Neither philosophy nor casuistry can explain how a man of evenly and well balanced mind, such as Mr. Martin has always fairly well maintained a reputation for possessing, could have failed to perceive the injustice which was likely to be done to innocent third persons when he left the printing office of THE ELECTRICAL WORLD on that Saturday, the 8th of February, 1890. At that time the paper was by no means ready to go to press; Mr. Martin was the editor of the paper; he was, also, the vice-president of the company, and besides that a stockholder and a sharer in the money which was taken and received from the paper's advertisers. He admitted as a witness, that he knew the paper had to go to press that night, if it was to be shipped to Kansas City the following morning, and if not shipped then it could not have been distributed at the Electric Light Convention on Tuesday morning. He also knew that the company was obligated not only by contract, in some instances, but by honor in all to have it there in fulfillment of arrangements made with its advertisers, many of whom Mr. Martin told us with considerable flourish from the witness stand were personal friends of his own, and whose advertisements he was largely instrumental in securing, and thus to whom we suppose he was bound, not only by the sense of duty he felt resting upon him arising from the fact that he was actually receiving their money as editor of the paper and a stockholder and officer in the company, but by the friendship to which he laid claim, to do to the full extent of his power his part to realize their expectations that the paper, and thereby their advertisements, would be promptly on hand before that convention on Tuesday morning. Yet if any one of these ties had any strength with him, they certainly had not force enough to keep him at his post fulfilling the obligations we have pointed out. When a quarrel (putting it in his own way), arose between himself and the president of the company, neither friendship nor anything else stayed Mr. Martin in his going. Had it not been for the exertions of others working late in that printing office on that night, the advertisements of his "personal friends" would never have reached Kansas City. This is one of the most curious of the many strange things which the details of his performances disclose. The harshest thing we shall say about him now is that if on that night he was bound by even friendship toward his friends who were advertisers and contributors in the paper—largely on his account, if we are to take his own word for it—and leaving entirely out of sight the other ties which should have bound him, he would not have left the printing office, no matter who the quarrel was with; and it would not be in our power to-day to write that which we have written.

Design of Alternating Current Motors.

BY EMIL KOLBEN.

There is no essential difference in the design of a single, two or three phase motor, and, in order to simplify matters, we shall treat the problem for the single-phase motor only, noting, at the same time, the way how to apply the results to the design of motors of the multiphase type. We shall also consider the following typical form only, it being the simplest, the cheapest and most economical, and therefore of chief commercial interest and value. It consists of two essential parts: 1. The external, stationary, inducing part or "field" A (see Fig. 1), made of a subdivided iron

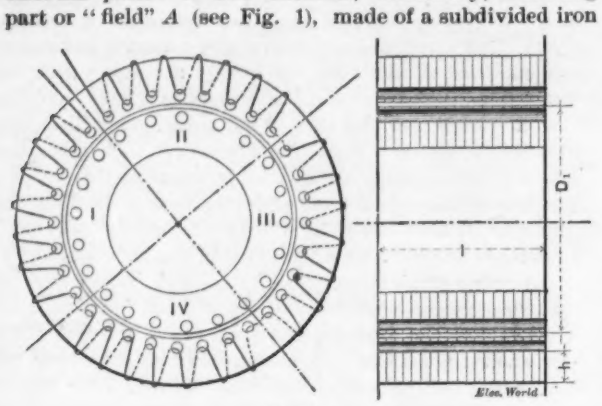


Fig. 1.

body, with a continuous ring or drum winding imbedded in grooves or holes, and wound so as to form two, four or more poles. 2. The internal rotating induced part B, the

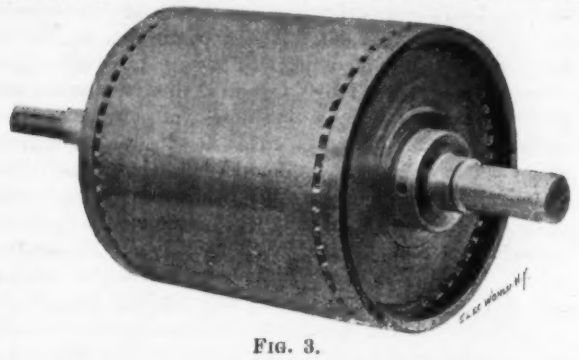
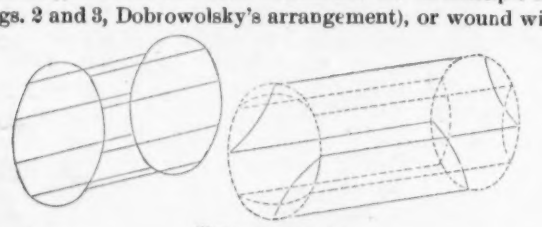


Fig. 3.

armature, with a winding closed in itself. This latter may be arranged with the bars connected all in multiple arc (Figs. 2 and 3, Dobrowolsky's arrangement), or wound with



Figs. 2 and 4.

a number of sections independent of each other (Figs. 4 and 5), each section with a ring or drum winding,

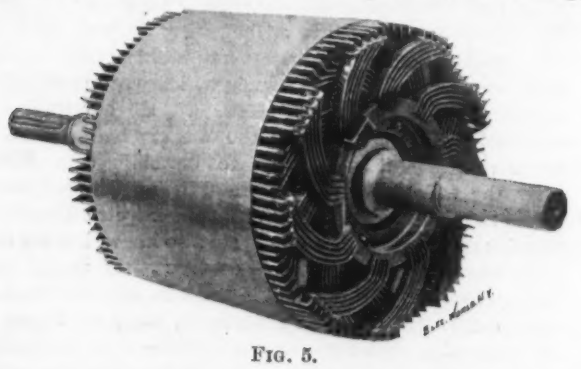


Fig. 5.

made so as to form as many poles as are formed by the external field winding. The first arrangement can be treated as a special case of the second.

Let it now be required to design an alternating current motor of the single phase type, to deliver a power of P effective mechanical power units (h. p.) equal to $W_1 = 736\ P$ watts at its pulley: *Required to find the iron dimensions of the field and the armature, the number of turns and the sizes of wires of the inducing and the induced circuits at a given impressed E. M. F., and finally the efficiency of the motor.*

The first point to settle upon is the axle speed of the motor, V. This is determined by the frequency of n periods per second and the number of pairs of field poles p. From these we find the number of revolutions per minute:

$$V = \frac{60\ n}{p}. \qquad (1)$$

The motor will have very nearly this theoretical speed when it is running free. At full load we shall allow a slip of $\frac{1}{s}$, so that the speed of the motor when it is loaded is: $V - \frac{V}{s} = V\left(1 - \frac{1}{s}\right)$. If, for example, the slip is 4 per cent., then $\frac{1}{s} = \frac{1}{25}$, and the full load speed $\frac{24}{25}V$. Thus we find for a circuit of low frequency of 50 cycles and for one of high frequency of 130 cycles the following theoretical speeds:

Number of poles of motor.	V at 50 cycles (revs. per minute).	V at 130 cycles (revs. per minute).
4	1,500	3,900
6	1,000	2,600
8	750	1,950
10	600	1,560
12	500	1,300
16	375	975
20	300	780

From this simple comparative table we draw at once the important conclusion that the low frequency is preferable for the design, as it permits of reducing the number of poles. At 50 cycles we can limit this number to between 4 and 8 for motors from 1 to 50 h. p., while we need for the same sizes 10 to 20 poles at the high frequency of 130. We shall see, later on, that the idle or magnetizing current increases directly with the number of poles, and this fact is no doubt one of the main reasons of the difficulty of designing good motors for high frequency circuits.

I. Design of the Field.—The important question to consider is the proportion between iron and copper weight in the field. Similar considerations as in the design of transformers may take place. The maximum induction density B in the iron is given by the frequency, the permissible loss and the heat radiating surface. B will in general be the same as in well-designed transformers, and it is advisable to take the following values:

For 40 cycles	B =	6,500 to 5,500
" 50 "		6,000 " 5,000
" 60 "		5,000 " 4,500
" 80 "		4,500 " 4,000
" 100 "		4,000 " 3,500
" 120 "		3,500 " 3,000

It would not be difficult to find by theoretical investigations the best relation between the weight of iron and copper, but by experience on a large number of designs I found that with the normal values of the induction in the iron an empirical constant can be found, by means of which the number of field turns N can be easily chosen.

This constant C is the *number of ampère turns per centimetre circumference of the bore of the field* (or of the diameter of the armature, as the two are quite nearly equal). Let D_1 centimetres be the armature diameter [it can be found from the permissible circumferential speed $U_1 = 1{,}500$ to 2,500 centimetres per second, and V by:

$$D_1 = \frac{60\ U_1}{\pi\ V}] \qquad (2)$$

and I the $\sqrt{\text{mean}^2}$ value of the current in ampères at full load; then the constant will be expressed by

$$C = \frac{I\ N}{\pi\ D} \qquad (3)$$

For frequencies of 40 to 80 cycles and an induction density in the air gap of 2,000 to 3,000 C will vary from 100 to 150. This rule, of course, is but "a rule of thumb" and has to be applied judiciously in each special case. From (3) we find the number of field turns

$$N = \frac{\pi\ D_1\ C}{I} \qquad (3^1)$$

In order to determine exactly the full load current, the exact value of the magnetizing or idle current i should be known beforehand. A method for calculating this will be given later on. But an approximation sufficiently accurate can after some experience readily be obtained by taking I a certain percentage larger than the true watt current $I = \frac{W_1}{\eta\ E}$, wherein η is the full load efficiency of the motor, and E volts the $\sqrt{\text{mean}^2}$ value of the impressed E. M. F. of the circuit. Two or three phase motors will have a comparatively larger number of field turns, as the resultant current of the phases must be taken in consideration. They will consequently be somewhat lighter.

The primary or inducing winding must be placed in holes or grooves uniformly all around the circumference, in order to reduce the air gap reluctance to a minimum. The width of the gap is given by the mechanical consideration of sufficient clearance between rotating and stationary part only, and varies between one and two millimetres from the smallest to the largest sizes.

From the total number of turns N (or wires, if drum winding is used) the maximum value of the total induction can be calculated after the well known transformer relation:

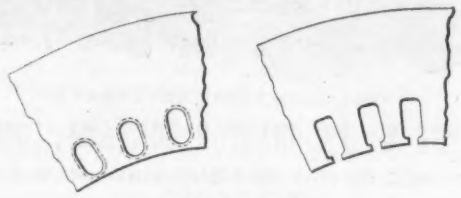
$$B\ S = \frac{\sqrt{2}\ .\ E\ .\ 10^8}{2\ \pi\ n\ N} \qquad (4)$$

wherein S is the effective cross section of the iron. B has the values given above for the various frequencies. Of this total induction only a certain percentage will be useful by passing through the armature and inducing in its conductors currents which will produce the required mechanical torque between them and the stationary field. The other portion will form a stray field through direct leakage from pole to pole, chiefly on the external surface of the iron body (Fig. 4). This leakage will increase with the size of the gap, with the induction density in it and in the iron and also with the number of poles. A ring winding will of course produce a larger leakage than a drum winding. The stray field increases with the increasing load and reaches an enormous amount in starting of the motor, when the ampère-turns on the field are many times larger than at load. At the moment of starting the useful induction is therefore reduced to a minimum, just at the time when a maximum induction most needed. Another source of leakage is the small iron bridges left between the holes for the winding (Fig. 5). By using a half closed groove as in Fig. 6, this leakage can be made negligible.

The useful total induction Z will therefore be expressed by

$$Z = x\ S\ B \qquad (5)$$

where x is a fraction less than unity. If the motor is running loaded at normal speed, x can vary according to the



Figs. 6 and 7.

design from 0.95 to 0.70; the author has found the values by various experiments.

From the effective iron section S the iron dimensions h and l (Fig. 1) are found by

$$S = 0.85\ h\ l,$$

by making an allowance of 15 per cent. for the paper insulation between the iron discs. In order to determine the length of the field l we chose the maximum induction density B_1 in the air gap with the view that the magnetizing current will increase in direct proportion with this gap density. If the motor is wound for 2 p poles, then the effective iron surface of one pole will be $\frac{0.85\ \pi\ D_1\ l}{2\ p}$ and the useful total flux through one pole:

$$2\ Z = \frac{0.85\ \pi\ D_1\ l\ B_1}{2\ p} \qquad (6)$$

From this we find

$$l = \frac{4\ p\ Z}{0.85\ \pi\ D_1\ B_1}$$

and by inserting the proper value for Z from equations (4) and (5):

$$l = 0.34\ \frac{x\ p\ E\ 10^8}{D_1\ B_1\ n\ N} \qquad (7)$$

and

$$h = 0.78\ \frac{B_1\ D_1}{x\ p\ B} \qquad (8)$$

For 40 to 80 cycles and a small gap B_1 may be taken from 4,000 to 2,500. With these dimensions of the iron body and with the induction densities given the iron losses by hysteresis and eddy currents in the field can be readily calculated. The total length of the copper winding and its resistance can also be found and the copper loss in the field thus determined.

II. Design of the Armature.—The problem of starting shall be considered separately. For the present let us assume that the motor is giving off its normal output of W_1 effective watts causing it to run with a slip of $\frac{1}{s}$ at a speed of $V\left(1 - \frac{1}{s}\right)$. If the motor was running at its theoretical speed then there would be no E. M. F. induced in the armature conductors, as then there would be no difference between the speed of the armature conductors and that of the rotation of the field induction. By virtue of the slip, however, an E. M. F. is induced in the armature conductors producing currents in them whose strength depends upon the value of the slip and the armature resistance R_1. The mechanical work performed by the motor will depend upon these currents. They will produce in the armature conductors a certain watt loss w_1, which together with the slip is at the same time a direct measure for the useful work performed by the motor.

Suppose the armature is wound in u sections of m conductors each, these m conductors being connected in series; each of the sections to be short-circuited in itself, independently of the rest. Let r_1 be the resistance of one conductor (including the connecting wires) and $R_1 = m\ r_1$, the total resistance of one section. At an induction density B_1 produced by the field (Fig. 6), at the slip $\frac{1}{s}$ and a circumferential speed $U_1 = \frac{\pi\ D_1\ V\left(1 - \frac{1}{s}\right)}{60}$ the E. M. F. induced in m armature conductors connected in series, each of the induced length l (Fig. 1), will be:

$$E_1 = \frac{m\ l\ B_1\ U_1}{10^8\ s} \qquad (9)$$

The copper loss in all u sections of the armature is thus:

$$w_1 = u\ \frac{E_1^2}{R_1} \qquad (10)$$

As the motor runs with the slip $\frac{1}{s}$ against the load, the total watts delivered by the motor must be s times as large as armature loss, viz.:

$$W = \frac{E^2_1}{R_1}\ u\ s$$

and as $W = W_1 + w_1$, we find the useful mechanical energy delivered at the motor pulley:

$$W_1 = \frac{E_2{}^1}{R_1}\ u\ (s - 1) \qquad (11)$$

By inserting the proper value of E_1 from (9) in (11) and considering that $m\ u = N_1$, which is the total number of conductors all around the armature, we find the important equation for the useful motor output:

$$W_1 = \frac{N_1{}^2\ l^2\ B_1{}^2\ U_1{}^2}{10^{16}\ u\ R_1}\ \frac{(s-1)}{s^2} \qquad (12)$$

and from this the resistance of one armature section

$$R_1 = \frac{N_1^2 l^2 \bar{B}_1^2 U_1^2}{10^{16} u W_1} \frac{(s-1)}{s^2} \qquad (13)$$

The $\sqrt{\text{mean}^2}$ current in the armature conductors in amperes

$$I_1 = \frac{E_1}{R_1} = \frac{m l B_1 U_1}{10^8 R_1 s} \qquad (14)$$

or expressed directly by the useful watt output:

$$\bar{I}_1 = \frac{10^9 W_1}{U_1 N_1 l B_1} \frac{s}{s-1} \qquad (15)$$

The formulæ (12), (13) and (14) speak a clear language, and from them we see clearly what factors determine chiefly the output of an alternating current motor.

These equations are general, and in the case of a closed circuit armature according to Dobrowolsky's design (Fig. 2) we have the special condition of $u = 1$, and the armature resistance has to be calculated with the view that all the armature conductors are connected in multiple arc through the two end rings.

(To be continued.)

The Brooklyn Institute of Arts and Sciences.

The prospectus of the Institute for 1893 and 1894 gives notice of eight illustrated lectures on electricity, the lecturers and dates to be announced later. Leading electrical experiments that are new or comparatively new to the science of electricity will be repeated before the department during the year under the auspices of a special committee. A large electrical exhibition will be given, if practicable, by the department, at the Clermont Avenue Rink, for three weeks. A special committee has been appointed to make arrangements for the exhibition. Mr. W. J. Hammer will deliver a lecture on the electrical exhibits of the World's Fair.

Laboratory Notes.—VI.*

BY LIEUT. F. JARVIS PATTEN.

An ordinary alternator having a large outside ring of poles can be safely driven at 50 revolutions a second, but in a form and size suitable for such a speed it is hardly practical to have a hundred poles so as to get 5,000 reversals a second, besides such a machine once built is practically fixed, as no wider range of output can be had than such as will result from a change of speed alone. It is different, as will be seen, with a Gramme ring placed in a single field, as the different possible ways of connecting the winding to the collector greatly increase the range of output with a fixed number of coils and collector segments. The general plan of connecting such a ring is indicated in Fig. 4,

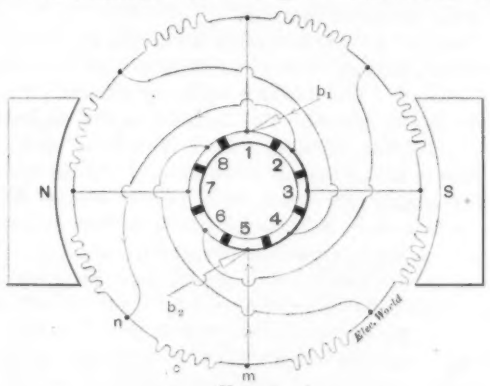


FIG. 4.

which shows an ordinary Gramme ring having successive points of the winding alternately direct and reverse connected. The diagram shows only eight points or coils of the winding so connected, but there may evidently be a very large number connected to as many segments in the same way, and such a ring, driven in a two-pole field, will deliver a current that is reversed as each successive pair of segments comes under the brushes.

The current derived from such an apparatus is, of course, not a true alternating current, but simply an interrupted current of rapidly reversed impulses, and has but a limited field of application. For operating induction coils and similar apparatus, however, it offers some points of advantage over the ordinary vibrators that are used to interrupt a primary battery circuit, for with even this form of ring and commutator arrangement the pulsations will be very uniformly spaced, and free from such irregularities as are due to the sticking of the vibrator contacts, which seriously affects both the intensity and the duration or uniformity of the impulse. How to get a true alternating current from a device of this sort, or at least a close approximation to a true alternating current, and how to prevent the sparking incident to the short circuit that is produced when the brushes pass from a pair of direct to a pair of reverse connected segments of the collector will be shown presently. The method indicated of simply obtaining rapidly reversed impulses is given here as a starting point from a consideration of which other dependent systems of armature connection will appear less complex.

Considering such a device for the moment as a convenient means of producing rapidly reversed impulses of only moderate current and E. M. F., so that the sparking will not be significant with even the simple form of arrangement shown, you see that it is by no means necessary to provide such a ring with a cumbersome pair of field poles for excitation.

A better plan is that shown in Fig. 5, where two separate windings are indicated on the same ring and a separate collector for each with its own pair of brushes. One winding shown outside the other to avoid confusion of the circuits, and which may have a less number of

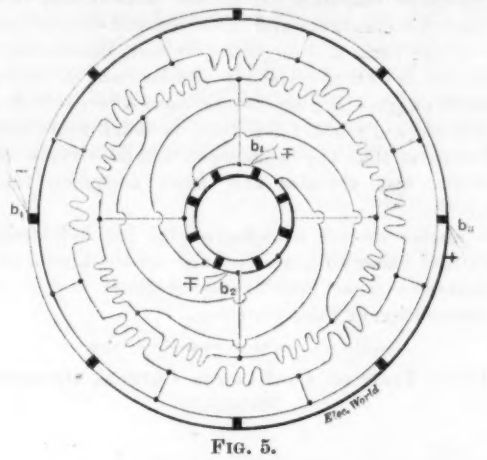


FIG. 5.

coils than the other, is connected to its collector in the ordinary way. This serves as an exciting circuit; direct current is introduced to this winding through its brushes b_2 b_4, which maintains a fixed polar line in the ring as it revolves, as would a pair of field poles embracing the ring in the ordinary way. The other winding has the direct reversed system of connections, and the brushes b_1, b_2 bearing on this collector deliver reversed currents to an external circuit connected to them. It should be remembered that the maximum output will be given when the brushes belonging to one collector are on a line at right angles to that joining the other pair; and, by simply varying this relation, the voltage can be changed from zero to a possible maximum. The machine thus arranged is a sort of rotary transformer, the incoming direct current of one winding primary being given off from the other as a pulsating reversed current, and as such it is a simple and convenient apparatus for obtaining such currents as are used in the ordinary medical induction apparatus. A small armature, about eight inches diameter, with 36 coils or sections, is a suitable form; 12 coils will be used for the primary winding, and the other 24 may be well connected in groups of three direct, then three reversed, which gives eight reversals to a revolution, or 320 a second, at a speed of 40. This apparatus may be driven by hand, but preferably by a small motor, if a uniform speed is desired. A system of connecting and operating such a motor transformer, shown in Fig. 6, is interesting, not only as being a step in the direction of obtaining a true alternating current from an apparatus of this description, but also as a means of obtaining from an induction coil almost the identical effect obtained if the primary of such a device could be supplied with a very uniformly interrupted direct current, or a direct current undergoing very uniform variation, which, of course, is not attainable with vibrators and other like methods of rapidly making and breaking contact, no matter how uniform may be the undisturbed action of the spring or mechanism used to work the make and break. The system, Fig. 6, supposes an independent, separately excited field, as indicated by the pole pieces N S, and there are two windings on the ring, as before, but having exactly the same

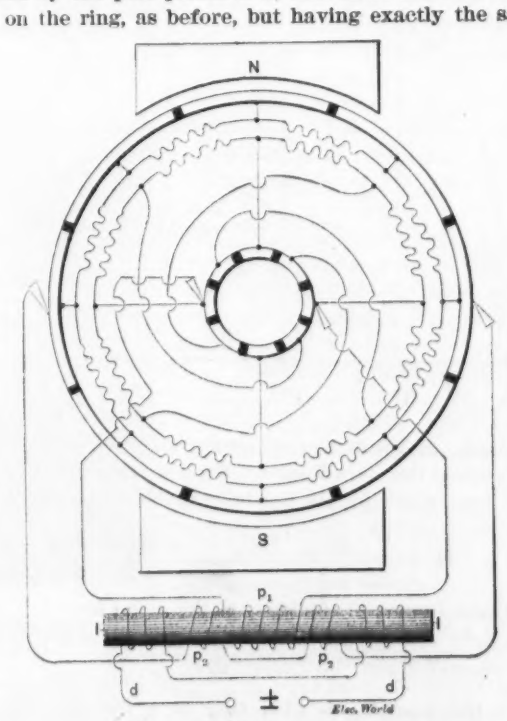


FIG. 6.

number of coils and turns; also separate collectors and brushes; both systems are in all respects the same, except that one is connected in the ordinary way and the other is connected direct and reverse at alternate segments. The two pairs of brushes are placed in line and

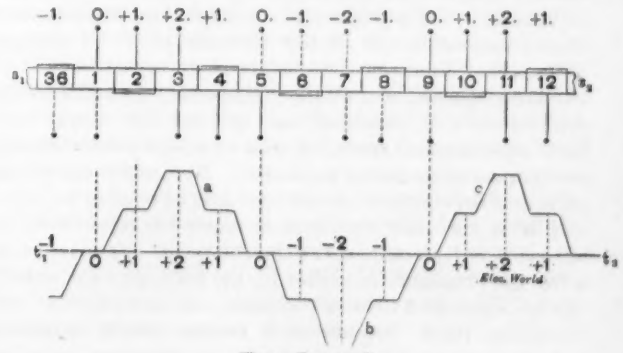
circuits connected to each pair are made a double primary winding, p_2 p_1, of the induction coil I, provided with a secondary d d.

From the armature connection it will be seen that the currents from the two windings will be alternately in the same direction and alternately opposed in direction, though in different circuits, as the armature, in turning, presents successive pairs of segments to the brushes. As a result of this, the induction coil I will be excited alternately by two currents in the same direction, and then by the same two currents in opposite directions, from which it will receive a fluctuating magnetization varying between a fixed maximum and some value that will always be greater than zero. The current in the secondary of this induction apparatus will then be a current without breaks or interruptions, and as it must reverse or change sign with the increasing and decreasing magnetization of the iron core, the secondary current will be some form of alternating current.

It is but a step from the consideration of the system just described to that of an arrangement of ring windings and connections that will give a true alternating current having any desired number of complete periods per single revolution of the ring in a two-pole field, and it is assumed that such a current should not only be reversed in direction at each alternation, but should also rise gradually to a positive or negative maximum value, and as gradually decline to zero; this result is obtained by the system of connections that will next be described.

Referring again to Fig. 4, and supposing the ring to have turned until the brush b_1 is bearing on segments 1 and 2, bridging them, while brush b_2 bears on both segments 5 and 6; then current entering through brush b_1 would flow from segment 2 through the reversed connection to n, through coil c, to m, and by the direct connection to brush b_2 on segment 5, thus short-circuiting the entire armature, excepting the single coil c. This is a serious defect in such a system of connections, and cannot, of course, be left without remedy. The simple and obvious remedy is to separate the segments from each other at points where the change is made from direct to reverse connections by an idle or insulating segment that is not connected to any part of the winding, and then if the brush point is not considerably broader than an entire segment, this will prevent the short circuiting of the armature. The plan is referred to only as a possible remedy for the defect, and will answer only in cases where small currents and a low E. M. F. is used, for the insulating segment opens the armature circuit momentarily, and with anything like strong currents or high electromotive forces the sparking at the insulating segments will be very bad. For small currents, however, not more than 10 or 15 amperes at 100 volts, the device will not give trouble, providing the iron of the ring is well laminated, and the ring itself is not too large—for it must be remembered, especially in connection with experimental work, that the sparking at commutators and at all points where a circuit is opened is not controlled entirely by the voltage and current flowing in the circuit at the time of breaking, but is largely due to the magnetic reaction set up by a sudden collapse of the lines of force in the magnetic circuit, and so depends largely upon the amount of iron in the system.

The defect of short-circuiting the armature windings, and that of opening the armature circuit which occurs when an idle segment is introduced to prevent the former, is overcome by the introduction of an equal and opposed E. M. F. at the point of breaking the circuit containing the opposed E. M. F. being connected to the idle segments. There are two independent windings on the ring having the same number of coils and turns in each. Supposing 48 coils on the ring, every other coil connected in series would constitute one winding, and the intermediate coils the other, making two windings of 24 coils each. In each winding the 24 coils are arranged in groups of three, which are alternately direct and reverse connected, three coils direct, then three reverse, and so on around the winding, making therefore eight reversals to a revolution of the ring. Now both windings are connected to the same collector



FIGS. 7 AND 8.

segments, after the manner indicated in Fig. 7, which shows the first 12 segments of the ring with their proper connections. The connections to one winding are indicated above the segments, and those of the other as extending downward from the segments; and

*Continued from THE ELECTRICAL WORLD of Oct. 7.

when a connection is direct it is shown as a full line, and when reversed it is shown as a dotted line, and there is an idle segment between each group of three direct and three reverse connections, so that for 24 coils there will be $8\times3+8=32$ segments. The idle or separating segments of one winding, however, are always active or connected segments for the other, so that there is never any rupture of the entire armature circuit and the zero period is not produced by opening the armature circuit, as before, but by introducing at every fourth segment two equal and opposed electromotive forces caused by connecting such segment direct to one winding and reversedly to the other. Thus referring to Fig. 7, segment 1 is connected to one winding direct and to the other reverse, the resulting E. M. F. being zero. Segment 2 is connected to one winding direct and is a blank or idle segment for the other winding, not being connected to it at all; this will give an E. M. F., say, + 1. Segment 3 is connected direct to both windings, giving an E. M. F. + 2.

Following the connections, it will be seen that the successive resultant E. M. Fs. plotted will give an electromotive force or current curve like that shown in Fig. 8, passing at each four segments through zero to a positive and negative maximum value. This system requires but a single commutator and a single pair of brushes, and if a circuit connected to the latter is made the primary of an induction coil or transformer the secondary induced current will be a true alternating current.

(To be continued.)

Judging the Electrical Exhibits at the World's Fair.—V.

BY HERMANN S. HERING.

XII. Conclusion.—The report which the judges are preparing promises to be quite elaborate, and will contain much valuable matter and is to be published in a separate volume, though forming a part of the final history of the Exhibition. It is the intention to have this matter go to press promptly, which will add greatly to its value.

Had it not been for the successful efforts of the judges in overcoming the many obstacles placed in their way by the authorities, nothing but a mere examination of the exhibits would have been made. As it was, but a few tests of any great value were made, most of them being in the nature of ordinary examinations which did not bring to light any new or important information but simply indicated the performance of the apparatus.

The original plan of making exhaustive tests, the results of which were to be reduced to a uniform basis and to become standards of reference for a long time to come, which plan induced several of the judges to accept their positions, was ideal, but was impossible to execute, as the authorities failed to make proper provision. The judges were thus hampered not only with the tests but also with the judging, by other bits of executive inefficiency, and so taking everything into consideration the judges are to be congratulated on accomplishing as much as they did. The pure judging of the exhibits was conducted in a thorough, impartial and careful manner, and the awards only given upon positive merit; the tests, on the other hand, were few in number, and in all but two or three cases were simply made as a guide rather than as a source of new and important data.

There is very little reliable and classified data at hand at present about electrical machinery and mostly old data about mechanical machinery, as the development has been so rapid and no general tests have been made since 1884. All of the data at hand are from individual tests of different makes, made under different conditions, by different observers and only more or less complete and reliable. In addition, these data are scattered around in various books, papers and private notes and it is only with the greatest difficulty that comparative results can be obtained. Take, for example, street railway motors.

Tests have been made upon various makes, some in the laboratory, some on the road, and all more or less complete and made under as many different conditions, and worked up on as many different systems and schemes and along as many lines as there were experimenters, thus making a collection and classification almost useless and a comparison for purposes of research and improvement almost impossible. If all the varieties of street railway motors had been tested under the same conditions and on the same scheme, and all the various curves and cut-outs determined and classified, the information would have been of immense value; so also with other electrical and mechanical engineering apparatus. Mere opinions of experts and the results of rough tests are, of course, valuable, and it is fortunate that even so much has been obtained; but yet it is deplorable that exhaustive and standard tests were not arranged for earlier in the history of the exhibition on a par with the completeness and grandeur of the exhibition itself, because such results would have been welcomed the world over, and been of immense value to the electrical and mechanical engineering profession.

It must not be supposed that the judges are to blame for any of these shortcomings, as they have shown great earnestness and rare discrimination in their work and undoubtedly done the best work in judging of any of the departments. The responsibility for any lack rests entirely with the Exhibition authorities and their advisers for not providing an early organization, suitable facilities and requisite funds. Such an opportunity as the Exhibition afforded for making thorough and complete tests and examinations of prime movers, generators, motors, central station appliances, transmission machinery and various electrical and mechanical contrivances has never before been available and may not be soon again. The value of an exhaustive classification of the dimensions, electrical and magnetic constants and variables, and data of performance of the various generators, motors, transformers and appliances, as well as relatively similar data of steam and hydraulic engineering appliances, cannot be overestimated, and this work should have been as much more elaborate and extensive than the famous Centennial tests as the one exhibition was grander and more complete than the other.

The author desires to acknowledge his indebtedness to judges and other officials through whose kind assistance the matter for these articles was obtained and to express his appreciation of their courtesy.

Efficiency Tests of Continuous Current Dynamos and Motors.*

BY FRANK P. COX

It very often occurs that a dynamometer for measuring mechanical energy cannot be obtained. Even under these circumstances an accurate efficiency test may be made, the only instruments necessary being an ammeter, a voltmeter and a speed indicator. In following this method the losses in the machine are first determined. These losses added to the output of a dynamo give the power applied at the pulley. If subtracted from the electrical energy delivered to a motor the result is the power available at the pulley. The loss in either a dynamo or a motor may be divided into wire loss, iron loss and friction loss. Of these the wire loss will depend upon the current flowing, but the other losses (iron and friction) may be considered constant for the same speed. In the determination of these losses the machine is run as a motor with the belt removed. It is evident that all the power delivered to the machine is waste, since no useful work is performed.

Consider the case of a shunt motor, the law being equally true for a series machine. Let C_a represent the armature current when the motor is running empty, R_a the armature resistance, C_s the field current, and R_s the field resistance. The wire loss is

$$C_a R_a + C_s^2 R_s.$$

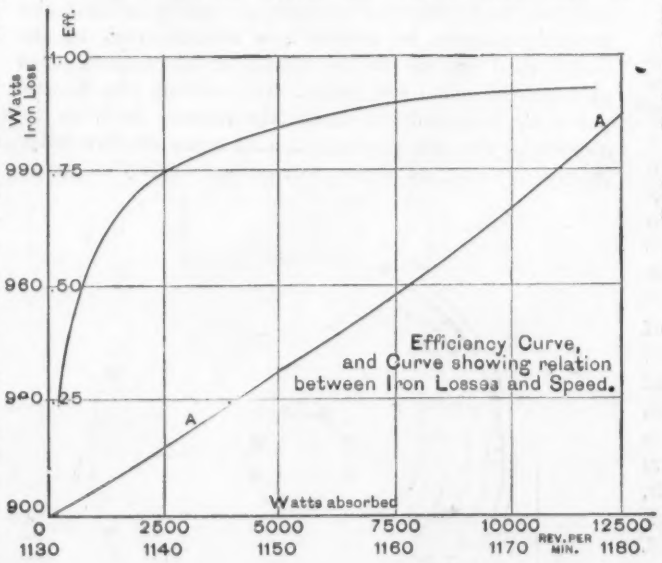
The total power expended is

$$(C_a + C_s) E,$$

where E is the potential difference of the mains. Then there are

$$(C_a + C_s) E - C_a R_a - C_s^2 R_s$$

watts not accounted for. This loss is due to Foucault currents, hysteresis and friction, and may be considered constant for the same speed. The motor should now be caused to run at different speeds by varying the strength of field, and this loss determined for each speed. If the speed of the motor is varied by means of a rheostat, care must be taken to subtract the loss in the rheostat. The losses due to Foucault currents, hysteresis and friction having been determined for different speeds the curve below may be



plotted. Revolutions per minute are plotted as abscissæ and watts loss as ordinates. Representing this loss by K, we may write for the power available at the motor pulley

$$\text{H. P.} = \frac{EC - \{C_a^2 R_a + C_s^2 R_s + K\}}{746}.$$

The commercial efficiency of the motor is

$$\eta = \frac{EC - \{C_a^2 R_a + C_s^2 R_s + K\}}{EC}.$$

If the machine is operating as a dynamo, the power applied to the pulley is

$$\text{H. P.} = \frac{EC + (C_a^2 R_a + C_s^2 R_s + K)}{746}.$$

The commercial efficiency is

$$\eta = \frac{EC}{EC + (C_a^2 R_a + C_s^2 R_s + K)}.$$

If the machine is now run at different loads, the efficiency curve above may be plotted. The value of K being taken from the curve A, it must be remembered that if the speed of the machine changes, the value of K must be changed to correspond.

The following test of a compound wound dynamo may prove of interest in this connection.

The machine was run at a constant load and measurements of current and potential taken. The losses were calculated by the method just described. Indicator cards were taken from the engine at intervals during the test. At the completion of the test the belt was run off the machine and several cards taken to determine the power lost in friction of the engine, shafting, etc.

Mean current in line	135 amp.
" " " field	1.7 "
" " " arm	136.7 "
" potential at brushes	240.5 volts.
" " over series coil	.734 "
Speed	934 rev. per min.
Electrical h. p.	43.5
Indicated h. p. absorbed in friction	17.6
Total indicated h. p.	66.4
Indicated h. p. at dynamo	48.8
Efficiency	89.3
Running as a motor:	
Main current	11.9 amp.
Field "	1.63 "
Armature current	10.27 "
Potential at brushes	230 volts.
" over series coil	0.5 "
Speed	935 rev. per min
Armature resistance	.025 ohms.
Field "	141 "
Total loss in motor	2,740 watts.
Wire loss in armature	2.64 "
" " " field	374.9 "
" " " series coil	.6 "
Total wire loss	378.14 "
Loss due to Foucault cur., hysteresis and friction	2,362 "

Having determined this constant loss, let us return to the results observed in the test:

Wire loss in armature	468 watts.
" " " series coil	99 "
" " " shunt field	408 "
Constant loss due to Foucault cur., hysteresis and friction	2,362 "
Total loss	3,337 "

Since the output is 135 ampères at 240.5 volts,

Watts output	= 32,400
" loss	= 3,337
" absorbed	= 35,737
Efficiency	= .907

This result, 90.7 per cent., as compared with 89.3 per cent. shown by the indicator, proves that there is no error introduced in assuming the value of K constant, for a variation of 1 per cent. is liable to occur from error in observation.

The error is no more likely to be in the electrical method than in the indicator method.

Although it is not necessary to divide the factor K, it is sometimes desired to do so in order to find the effect of certain changes. The factor is made up of friction, Foucault currents and hysteresis. The first step in the separation is to determine the friction. This is done by opening the field circuit of the machine and driving the armature at different speeds by means of a motor whose efficiency curve is known. Representing the power expended in friction by x, the loss due to Foucault currents and hysteresis is $K - x$. Now run the dynamo at two different speeds and determine the value of $K - x$ for each speed. Represent this loss at the speed r by a, and at the speed r_1 by b. Since Foucault currents are electric currents in the iron, both their potential difference and current willl increase with the speed, and the loss is proportional to the square of the speed. Hysteresis depends directly on the speed, and therefore we may write

$$mr + nr^2 = a. \qquad (A)$$

where m and n are constants to be determined. We may also write

$$mr_1 + nr_1^2 = b. \qquad (B)$$

Multiplying (B) by $\frac{r}{r_1}$ and subtracting from (A),

$$n(r^2 - rr_1) = a - \frac{br}{r_1};$$

$$n = \frac{ar_1 - br}{r_1 r^2 - rr_1^2}.$$

Multiplying (B) by $\frac{r_2}{r_1^2}$ and subtracting from (A),

$$m\left(r - \frac{r^2}{r_1}\right) = -a - \frac{br^2}{r_1^2};$$

$$m = \frac{ar_1^2 - br^2}{rr_1^2 - r_1 r^2}.$$

Therefore at a speed r the value of the Foucault current loss is

$$nr^2 = \frac{ar_1 - br}{r_1 r^2 - rr_1^2} r^2 = \frac{arr_1 - br^2}{r_1 r - r_1^2}.$$

The loss due to hysteresis is

$$mr = \frac{ar_1^2 - br^2}{rr_1^2 - r_1 r^2} r = \frac{ar_1^2 - br^2}{r_1^2 - rr_1}.$$

It is important in this determination that the value of β should be the same in each set of observations. If the potential difference is measured at the brushes at the different speeds, just before taking the readings, the fields should be so adjusted that

$$\frac{E}{E_1} = \frac{r}{r_1},$$

where E is the potential difference at the speed r, and E_1 that at the speed r_1. When this equation is satisfied the value of β is the same in each case.

* From "Continuous Current Dynamos and Motors: An Elementary Treatise for Students." By Frank P. Cox. (In press.) The W. J. Johnston Company, Limited.

The Electrical Features of Milwaukee.

NOT by reason of its dairy products, nor yet because of the lacteal bloom of its excellent beer, has Milwaukee received the name of the Cream City, but on account of the absence of iron in its clays, and the consequent yellowish whiteness of its bricks, has this peculiar cognomen been given.

It is related that in the dim ages of the past—that is to say, as much as a generation or two ago, at a time beyond which the memory of Milwaukee men runneth not back, when the air was clear and the site of the city had passed that stage in the creation of the world when "all was void," and when it had reached that further stage in development when one light had been placed in the firmament to rule the day and the lesser ones had been similarly placed to rule by night—when the waters had been partially divided from the land and the high places become dry land and the others swamp—the aborigines consumed all the red clays for war paint and left naught but the white for their successors. This was the situation when Juneau and Williams and others first killed bullfrogs on the banks of the Milwaukee and Menominee rivers, and nearly starved to death, notwithstanding an abundance of fish, by reason of an absence of salt with which to season them. This was the situation when they made the first bricks and were astonished at their creamy whiteness, and visitors looked askance at the yellow product, for that color was not in favor at the time. In those days the atmosphere was clear, and the yellowness of the brick persisted and was emphasized by the reflected rays of the unobstructed sun, but all this has been as much changed in the meantime as has the condition of the Chicago River. The swamps have been replaced by dry land, the hills have been capped by palatial structures, parks have taken the place of the waste places, and the croaking frog is no longer known save as a reminiscence. The whirr and buzz of machinery are heard on all sides, and the almost liquid smoke which belches from a thousand stacks has turned day almost into night—a great manufacturing city has taken the place of the bleak hills and desolate swamp.

If the atmosphere has been polluted by these waste products of the factory, it is not without its compensating advantages, and the sun's rays no longer strike unobstructed upon cream-colored brick, for the latter, like the chameleon, have taken on the color of their surroundings and are black before they are cold from the kiln, and the blush of shame for their color no longer tinges the cheeks of the native, for he will sometimes write his name with his finger upon the side of a building just to show you the real color of the brick, for

FIG. 1.—EXPOSITION BUILDINGS WHERE CONVENTION MEETS.

cream-colored brick, which is synonymous with Milwaukee brick, is now all the fashion.

But if the day has been obscured by the evidences of manufacture, the night in Milwaukee has been turned by the same tokens into day, for the engines there manufactured are some of them employed to turn armatures of great electric generators, and the electric light is distributed with a lavish hand throughout the area inclosed within the walls of the city. Street car lines, like the tentacles of a mighty octopus, reach out from a common centre to the north, to the west and to the south, and their routes may be traced by a man up a tree on the darkest of nights by the swiftly moving palaces of light which quickly and almost noiselessly skim over their excellent roadbeds. From the same point of vantage one may note that these moving palaces of light pass by numerous luminous areas along their routes, whence the strains of sweet music and the clinking of glasses rise grateful to the ears of the listener, for the visitor to Milwaukee must understand that he has come among a hospitable people, whose ways and manners are strongly Teutonic. The social element of the Vaterland seems here to predominate, at night at least, and

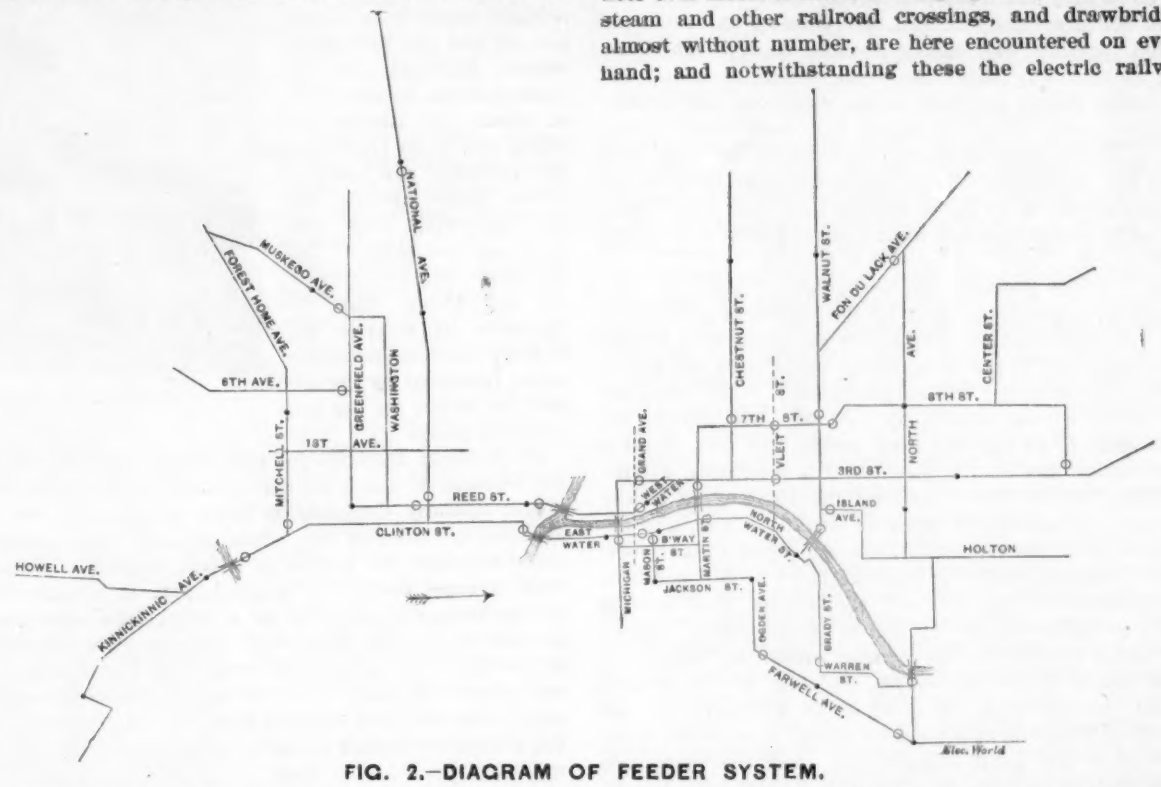


FIG. 2.—DIAGRAM OF FEEDER SYSTEM.

the amber beer and the pretzel dance together to the best of music, and the Wienerwurst is supreme. It is old Vienna with a modern setting—with better beer, better music, brighter light and as much sociability. The American and the Irishman have for the nonce become Germanized—they have "fraternized," if you will so translate the word, and all have become Germans, for Milwaukee is a German city.

But be it day or night, there is much in Milwaukee to interest and instruct the visitor, and a more lovely spot could not well have been selected for the meeting of the American Street Railway Association, which will be held in that city on Oct. 18, 19 and 20. This will be the twelfth annual convention, and it will meet this time under peculiarly felicitous circumstances.

Milwaukee, besides being Teutonic, is also enterprising, or perhaps the two terms are synonymous. One of her greatest prides for years past has been her industrial expositions, which have annually attracted to her doors the intelligent mechanics of the neighboring States. These expositions, which were at first an experiment, have demonstrated their right to continue, to such an extent as to have won for themselves a permanent home. The exposition buildings, as shown in the accompanying illustration, are ornate and substantial and cover very nearly a whole city block. These have been equipped with engines and boilers and pulleys and shafting and everything required for an exhibition of the mechanic arts, and here will be held the street railway convention and the exhibit of street railway appliances, which will be such an important feature.

The largest hall, which is on the main floor, has an area exclusive of the lobbies and conservatory of 340 by 140 feet, and in addition to this is the space afforded by a wide gallery extending around all four of its sides. All of this will be devoted to the exhibits.

The meetings of the association will be held in one of the smaller halls adjoining, known as Art Hall. This is located on the second floor of one of the wings, and is 44 x 88 feet in plan. It is well lighted and so conveniently adjacent to the exhibition hall as to bring these two features of the convention into closer harmony than has ever been possible before.

THE MILWAUKEE STREET RAILWAY SYSTEM.

Milwaukee has not only become celebrated as a convention city, but it is also known as possessing what in many respects is a model street railway system. When we say a "model" street railway system we mean, of course, one operated by electricity, for otherwise it could not be in all respects a model one.

For this reason, if for no other, the choice of cities for this annual convention was a fortunate one, for visitors will find much to interest them in this line. Nowhere, perhaps, have more difficulties been encountered than in Milwaukee, and certainly nowhere have these difficulties been more successfully overcome. It would seem that every difficulty that the constructing engineer ever meets is met here—high grades, dense foliage, steam and other railroad crossings, and drawbridges almost without number, are here encountered on every hand; and notwithstanding these the electric railway is found everywhere, and Milwaukee is one of the few large cities in the country in which the emancipation of the street car horse has been absolute and complete. But two years ago the motive power was everywhere horses. Within that period the separate endeavors of competing companies have been merged into one united endeavor of the consolidation known as the Milwaukee Street Railway Company, which is another striking example of how a single, well conceived and ably managed concern can better serve the public than can a number of smaller competing ones, however skillfully managed they may be. Not the least conspicuous advantage resulting from this absorption under one control of the various lines has been the system of transfers which was thus only rendered possible, enabling the passenger to ride on one fare over any or all of the intersecting lines, whereas otherwise as many fares were demanded as there were lines necessarily patronized in going from one point to another.

THE TRANSFER CHECK SYSTEM.

This system, which originated, we believe, with the Hinsey line, then consisting of three intersecting roads, employed transfer tickets printed in different colors, each significant of the road for which it was issued. Each ticket as issued to the conductor consisted of the ticket proper and a coupon, upon the former of which the name of the road is printed with the numbers of the hours from 1 a. m. to 12 p. m., and the names of the first or last six months of the year and the numbers from 1 to 31 inclusive for the days. Upon issuing the check the conductor punches the month, the day and the hour and detaches the coupon, which has no value to any one but to the conductor himself, who returns it to the receiver's office, and for each coupon so returned receives in exchange a new transfer ticket without extra charge. The transfer ticket without the coupon is received and registered by the conductor to whom it is presented as a cash fare, so that by no possibility can the company be defrauded either through collusion of its employees or through improper use of the transfers. The color of the check indicates at once the line whence the transfer was made, and the punched dates the time of its issue. This system works as well in practice, we understand, as it does in theory, and its extension over the whole system has closely followed the absorption of the various lines.

The regular fare in Milwaukee is, of course, five cents, but 25 tickets are sold for a dollar. Children's tickets are three cents, and besides these there are issued employees' tickets, and complimentary tickets are issued to policemen and city officials. No one is allowed to ride without presenting a fare or a ticket.

THE PERMANENT WAY.

The Milwaukee street railway system, which now comprises all of the street railways in Milwaukee, was originally operated by four distinct companies, but these have been absorbed one after another until the last independent line, the Becker line, having been gathered to the fold during the past summer, gave an aggregate

of 100 miles of track. On these lines the most difficult grade is that on the Sixth street branch of the Hinsey line, which for two blocks reaches about 10 per cent., and the next most difficult grade is that at the end of Centre street, which for a block and a half reaches 6 per cent. Most of the roadbed—viz., that within the city proper and originally laid by the Milwaukee Street Railway Company—is most substantially built, and consists of a specially designed girder rail weighing 69 pounds to the yard, which was rolled especially for the purpose by the Illinois Steel Company, of Chicago, some of the same pattern weighing but 59 pounds, and some of the well known Johnson rail weighing 63 pounds to the yard. All of these are spiked directly to the cross ties, which are placed very close together. Besides being specially braced, the ends of the rails are bolted together with heavy 30-inch, six-bolt fishplates, and in this way there has been obtained one of the smoothest riding roadbeds it has ever been our fortune to ride upon. Great attention has been paid to the curve, switch and crossing construction as well, and time has demonstrated that the extra expense involved in the attention to these details has been more than repaid by the diminished wear both of tracks and rolling stock.

One of the greatest improvements adopted by this company, appreciated alike by the traveling public and the company's ledger balance, is the compound transition curve, which has everywhere supplanted the single centre curves of the earlier construction. The standard for all its curves, which, by the way, are similar for both ends, is as follows: First radius, 200 feet, chord 5 feet; second radius, 100 feet, chord 5 feet; third radius, 66.6 feet, chord 5 feet, making the total angle of the transition 8 degrees 36 minutes, length 15 feet, and departure from the tangent at the end equal to 0.87 foot. The succeeding radius is made as large as the width of the streets will permit, and the second transition is made as before stated, by curves of successive radii of the same lengths in the reverse order. By means of these spiral transition curves, as they are sometimes called, the cars pass onto and off of the curves at full speed without the disagreeable shock inseparable from curves of the usual construction, and the saving in wear both of wheels and of track has been fully demonstrated by nearly two years' experience in Milwaukee.

Another feature of the curves in Milwaukee is the guard rail adjacent to the inner curve of the track. For this purpose use has been made of the old flat rails formerly employed before electric traction was introduced. These, after being bent to the curve, are placed edgewise between chairs four inches high and the girder rail, being separated from the latter by cast iron fillers, and held in place by bolts.

THE ELECTRICAL EQUIPMENT.

Both centre pole and span wire suspension for the trolley wires are employed in Milwaukee—the former predominating, in fact being almost universally employed in the central portions of the city, and the latter being the more general in the outlying districts. The centre pole used is of the lattice type, and is, as far as centre pole construction can be, ornamental, but we are under the impression that the span wire construction is now preferred. In the first place, it is undeniable that the centre pole obstructs the street, and is objectionable on aesthetic grounds far more than the span wire. In the second place, unless the tracks are separated considerably farther than they are in Milwaukee, the cars come in dangerous proximity to the poles, and although we believe no accidents have yet happened from this cause, the centre poles remain a constant source of anxiety among the patrons of the road; and in the third place, experience has proved the superiority of the greater flexibility of suspension in span wire construction over the more rigid centre pole support, which results in frequent breakage of insulators and the deterioration of the trolley wheels.

The trolley wire originally used was No. 4 silicon bronze, but this is rapidly giving way to No. 2 B. W. G. hard-drawn copper wire.

The feeder system is entirely under ground and carried in Edison tubes, as are the lighting circuits. Fig. 2 gives the scheme of feeding employed in Milwaukee, the dots indicating the points where the feeders are tapped into the trolley wires. The lines are also divided into sections, insulated from each other by cut-outs, the positions of which are shown on the same diagram by circles.

Milwaukee, like Chicago, is divided into several parts by rivers—in this case by the Menominee and Milwaukee rivers, which seem to confront one whichever way he goes, and which are crossed at some point in its length by nearly every street in Milwaukee. As these streams are navigable, numberless swing bridges have been necessitated, and the Milwaukee Street Railroad, in its ramifications, crosses eight of these. Of course provision had to be made both for carrying the current across these streams and for supplying the cars while on the bridges. All of these bridges crossed by the electric lines are operated by electric motors, the motors themselves being furnished by the city and the power by the railway company.

FIG. 5.—CHESTNUT STREET CAR BARNS.

The housing facilities for the electric cars are one of the features of which the management of the Milwaukee Street Railway Company is justly proud, and are unexcelled by those of any other city. Of the car barns there are four, the largest of which, located on Kinickinick avenue, corner of Mitchell, Fig. 3, was, as will be remembered, the scene of a most disastrous conflagration on Dec. 28, 1892, when 111 cars were destroyed. While the ruins are cleared away and a new structure has taken their place, many of the old trucks and equipments, warped and twisted, lying in a vacant lot near by, give mute though eloquent testimony of the damage wrought.

THE KINICKINICK CAR BARNS.

Located upon the same site there has already risen, in testimony of the energy of the management of the company, what all must concede to be the finest and most complete electric railway station anywhere to be found in this broad land. The dimensions of this structure are 263 by 243 feet. It has storage accommodation for 100 cars, distributed among 13 tracks. Directly south of the car house, and separated from it by a solid brick fire wall and iron doors, is the great storeroom, which, including the office in front, has a floor area of 60 by 170 feet. The storeroom, Fig. 4, is on a scale never before attempted in a street railway equipment, and has shelving sufficient, it would seem, to make our very largest supply houses envious, and a capacity which it would tax the energies of a number of our leading manufacturers for many weeks of continuous work to supply. It is evidently the policy of the management to keep everything on hand in the way of supplies that such a large system may ever need—probably in a belief in the adage that "A stitch in time saves nine."

Mr. H. De Steese is the proud monarch of this department, and is in his element when showing appreciative visitors over his domain.

At the other end, east of the storeroom, is the armature room, 60 by 40 feet, where the company rewind and attend to all other repairs to their armatures. This is very completely fitted up for armature winding, and, with a machine shop in the basement, the car house just north, and the supply room adjoining to the west, is located just right.

In the basement, occupying all of the space beneath the office, the storeroom and armature room—an area of 60 by 170 feet—and connected with the floor above by elevators for the convenient handling of materials, is the machine shop. This is equipped with all the machinery necessary for the work in hand, and here is discovered one of the great secrets of the smoothness of the company's roadbed; for, instead of trusting such things to those who have no other interest than to turn out a salable article, the company here make all of their own switches, curves, crossings, etc. Nothing of this character goes into the permanent way construction that has not been made under the direction and under the very eyes of Mr. Alexander W. Lynn, that prince of good fellows, to whom as master mechanic and superintendent of repairs and construction of electrical equipment so much of the success of the operation of the road is due. In fact, we understand, many of the admirable features of this station and of the other car barns, to which we will advert in the course of this article, are directly due to Mr. Lynn's progressiveness and efficiency.

Directly across the avenue, to the west, the company have secured a lot upon which they are erecting a building, to be coupled as a carpenter and paint shop.

Along the rear of the car barns runs the tracks of the Chicago North Western and Chicago, Milwaukee & St. Paul railways. Just east of these the company own five acres of land upon which they will build a new power house, which, it may be expected, will eclipse any thing of the kind heretofore attempted.

There are three other car barns, viz., the National avenue barns, located on the corner of National and Twenty-sixth avenues; the Farwell avenue barns, Farwell and North avenues; the Chestnut street barns, at the corner of Twenty-seventh street, Fig. 5, and the Third street barns at the corner of Burleigh street.

THE NATIONAL AVENUE CAR BARNS.

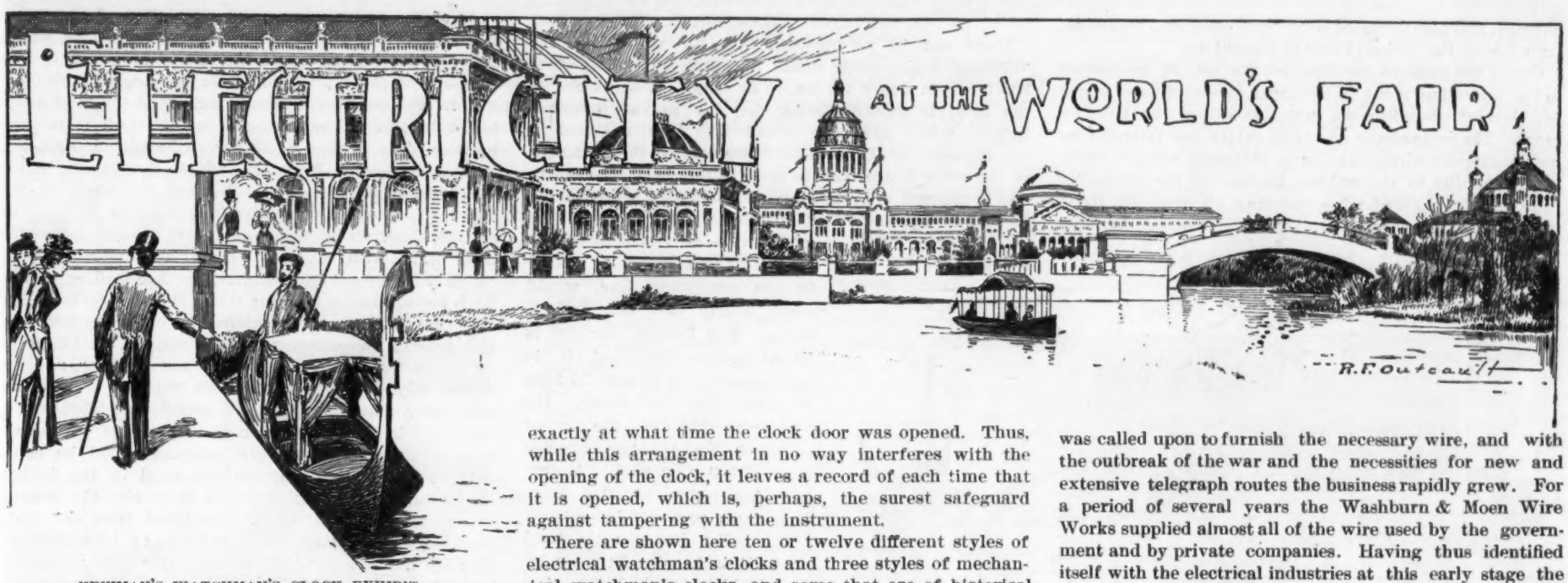
Nearly opposite the National Park, a pleasure resort of local repute, is located the barn under discussion. This is a one and one-half story brick structure, covering six tracks—the Chestnut street station has 10, the Third street 8 and the Farwell avenue 10 tracks. The

FIG. 3.- KINICKINICK CAR BARNS FROM THE SOUTHWEST.

FIG. 4.—NORTH AISLE OF STORE ROOM; KINICKINICK CAR BARNS.

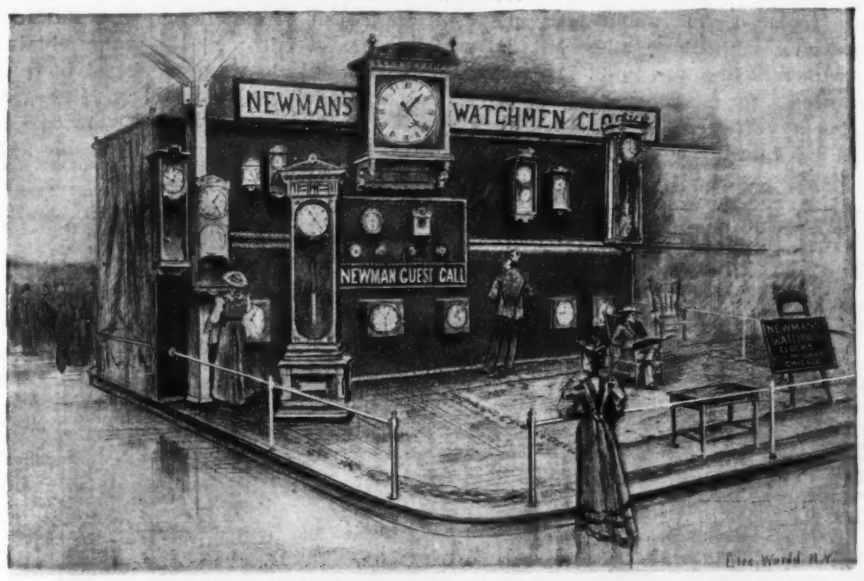
cars, on entering the house, run over pits which drain into the sewer in the street in front. These pits are all supplied with steam pipes coming from the boiler room in the rear, the office of these pipes being to melt the snow accumulations on the cars in winter. This most excellent idea originated with Mr. Geo. W. Hommell, the general superintendent, of whom we will have more to say further on. Thus, in snowy weather, when a car had gotten through with its trips, or between trips, it is run in over the pits; and, instead of the snow being allowed to freeze up, or gradually melt, to the injury of the apparatus, the steam is turned on, and it is rapidly melted and dried. At the same time the cars are thoroughly cleaned—a feat which cannot otherwise be performed when the atmosphere is down to zero. Back of the barn is a small repair shop where minor repairs can be made; also the boiler room before referred to.

(To be continued.)



NEWMAN'S WATCHMAN'S CLOCK EXHIBIT.

Almost directly opposite the cafe in the northwest bay of the gallery floor, in one of the most prominent positions in the gallery and in close proximity to two electric elevators, is the exceedingly interesting exhibit of Newman's watchman's clocks and non-interference signaling apparatus. In this space, which occupies the extreme north end of the block in which is located News-



A COLLECTION OF WATCHMEN'S CLOCKS.

paper row, Mr. Newman has erected a diamond-shaped exhibit board, upon which are shown some 30 pieces of his apparatus of various kinds, and some 80 of his instruments are in regular service in the Fair grounds.

The watchman's clock, which is one of the most important of these, is an extremely interesting and effective apparatus. In this he has accomplished by exceedingly simple means a set of selective signals such as would seem to require the employment of many circuits and very complex apparatus.

Aside from the clock proper, there is another dial face upon which is placed a paper dial divided into four quadrants of 12 hours each. Upon the face of this are drawn a number of concentric circles which are numbered from 1 to 30, thus permitting the connection with that clock of 30 or any lesser number of stations. The recording mechanism consists of a single needle and three pairs of electromagnets, and a single circuit connects these with all of the 30 call boxes. In the call boxes, which are operated by a key, a brush is caused to pass over a series of contacts, the number being different for each box, being two in excess of the number of the call box, and as this brush wipes across these contacts the needle in the clock moves radially across the concentric circles, step by step, until it has reached that circle corresponding to the number of the box whence the call was sent. There are two additional contacts which, as they are successively wiped over, cause the needle to prick the paper on the dial and then to drop back again to zero to be ready to record the second call. As will be understood, the puncture will always be made on the circle corresponding in number with the number of the box from which the call was sent. The line traced by the step-by-step movement of the needle as the call is sent in is always the same with regard to the clock frame, but as the recording dial upon which the impression is made is caused to revolve by the clock movement, the position of the puncture in each circle indicates also the time at which it was made.

As we have seen, as soon as a record is made the needle drops at once to zero, and that is its normal position. A catch on the door of the clock is so arranged that should the latter be opened at any time the needle will be caused to perforate the dial on the zero line, which puncture, by its relative position, also shows exactly at what time the clock door was opened. Thus, while this arrangement in no way interferes with the opening of the clock, it leaves a record of each time that it is opened, which is, perhaps, the surest safeguard against tampering with the instrument.

There are shown here ten or twelve different styles of electrical watchman's clocks and three styles of mechanical watchman's clocks, and some that are of historical interest. Among these are both clocks and dials made by Mr. Newman as far back as 1876.

The hotel-guest call, also shown, has a like simplicity. This is intended to be an auxiliary to the ordinary hotel annunciator, and by its means the guest, by simply moving an index finger across the dial of the instrument in his room to the proper point, has registered at the office his wants—whether it be ice water, stationery, bootblack or any other of the dozen or more things most frequently called for by a hotel guest and provided for on the dial in question.

The Newman guest call may be applied to any annunciator, either needle or drop, and in buildings already wired with push buttons can be installed by simply substituting the call for the push buttons and connecting the various instruments in series by another wire. The office of this extra wire is to close out all the other rooms while the call is going in.

These goods are manufactured and put on the market by the Newman Clock and Manufacturing Company, of 347 Ogden avenue, Chicago.

We have taken occasion several times in these columns of deprecating the absence of intelligent attendants in some cases at the Fair. We are happy to state that these remarks do not apply to the Newman exhibit, as Mr. Newman himself is in constant attendance.

DISPLAY OF THE WASHBURN & MOEN MANUFACTURING CO.

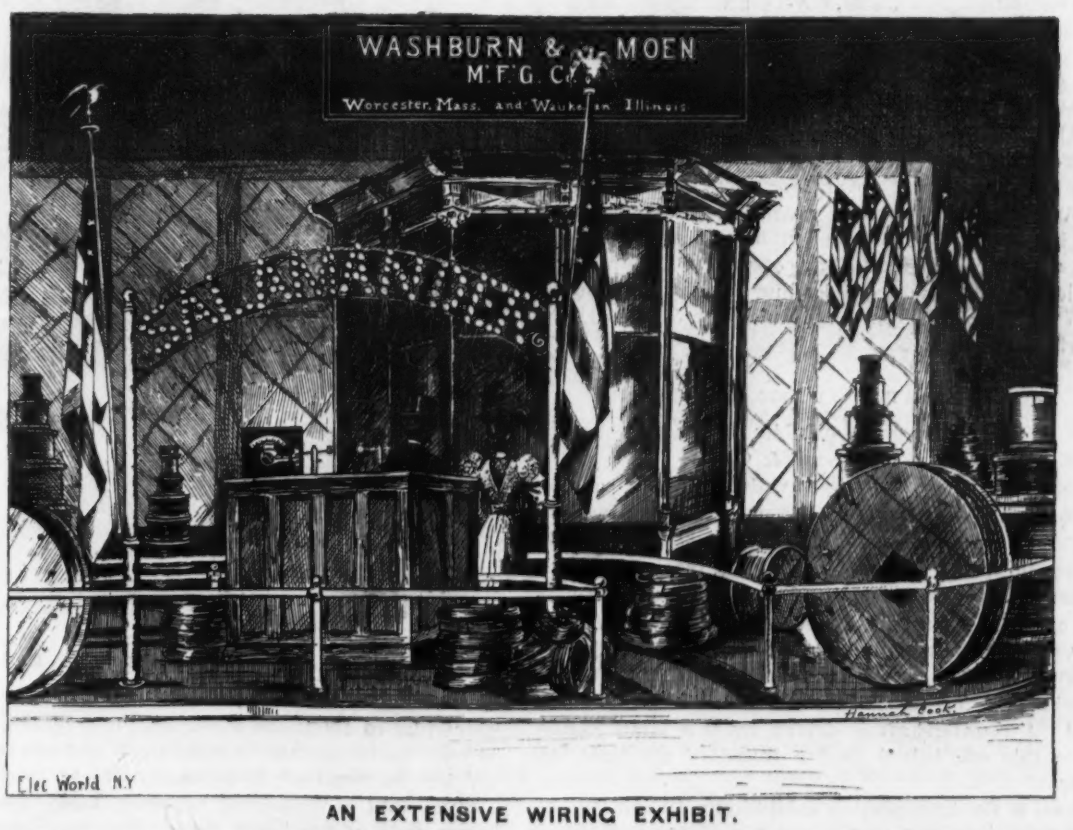
As early as 1831 the business of wire drawing was established in Worcester, Mass., by Ichabod Washburn, the founder of the company which bears his name. Up to the time of the introduction of the Morse telegraph there was practically no use for conductors of any kind in this country, but with the construction of telegraph lines this firm was called upon to furnish the necessary wire, and with the outbreak of the war and the necessities for new and extensive telegraph routes the business rapidly grew. For a period of several years the Washburn & Moen Wire Works supplied almost all of the wire used by the government and by private companies. Having thus identified itself with the electrical industries at this early stage the company took the initiative in perfecting telegraph wires from the crude conductors made from scrap or imported puddled iron in the early fifties down to the galvanized iron telegraph wires made from the best refined Swedish irons at the present day. It is claimed that the company's standard is higher than that demanded by any foreign government, in whose hands for the most part the ownership of all foreign telegraph lines is retained.

With the introduction of the telephone and the development of electric lighting and electrical power transmission large quantities of copper have been employed, and in the Washburn & Moen exhibit at the World's Fair are seen copper cables ranging from 2,225,000 circular mils, perhaps the largest conductor ever made, down to a fine copper wire No. 30 gauge, only .01003 of an inch in diameter.

The company has endeavored, from the outset, to manufacture conductors of the very highest conductivity, and they show in their exhibit hard drawn telephone wire with a conductivity of from 1 per cent. to 1½ per cent. higher than the standard established by the telephone companies, namely 97 per cent. of that of pure copper. (Matthiesen standard, in which the weight per mile ohm is equal to 871 pounds.) Tests on hard drawn telephone wire made by the company and entered at the World's Fair gave an average of 98.41 per cent., the highest, it is claimed, ever produced.

In the matter of annealed copper wires, such as enter into the production of magnet wires, insulated wires of all kinds, and aerial and submarine cables for light, power and sound, the copper wires exhibited by the company have also an extraordinarily high conductivity, running in their magnet wires, for instance, to over 101 per cent.

The display in Electricity Building includes copper bars of the company's own production, weighing over 200 pounds each, and smaller bars weighing about 135 pounds each; rolled copper rods of various sizes from ⅜ to ¾ of an inch; copper wires both bright drawn and bright annealed, of many sizes down to the finest in use; tinned copper wires, such as are required by insulators for rubber insulation, and for use in underground connections where there is danger of corrosion; copper cables and strands from No.



AN EXTENSIVE WIRING EXHIBIT.

00 B. & S. gauge up to 500,000 circular mils; solid and stranded conductors, with weatherproof insulation, from No. 0000 B. & S. gauge up to No. 10 B. & S.; wires and cables with fine rubber insulation, covering a range of sizes from No. 0 to No. 20; lamp cord, both silk and cotton

covered, and also fireproof lamp cord, office and annuncia tor wires of the various kinds in general use.

One of the greatest novelties in the way of conductors in the exhibition is the Salamander fireproof wire, which has been introduced by the company within the last two years. The Salamander wires and cables are intended for use in interior wiring, and as a safeguard against disastrous fires due to the sudden heating of the conductor from highly charged wires carrying currents for street railway, light or power purposes. The Salamander wire

A DOUBLE TANDEM COMPOUND ENGINE AT THE EXPOSITION.

as made by the company consists of, first, a standard rubber insulation equal in all respects to the best rubber wires produced, this factor being insisted upon by boards of fire underwriters. Outside of the rubber insulation is the fireproof insulation, composed entirely of materials which are not combustible and not inflammable, as is the insulation of all other wires.

A test was recently made by the electrical experts at the World's Fair on a No. 14 Salamander insulated wire, in which both ends of the Salamander wire were connected to the testing machine and a sufficient current applied to fuse the copper conductor and form an arc in the inside of the insulation. This was accomplished without even a particle of smoke arising from the exterior of the insulation.

Exhaustive tests have also been made by the Massachusetts Electrical Engineering Company, of Boston, to determine the insulation resistance test of the Salamander wire by immersion in water during 10 days and subsequently on the same cable by immersion of three days in lime water, this insulated wire showing a resistance of 4,400 megohms at the conclusion of this crucial test.

One of the leading electrical companies of the United States made a test of Salamander wire, using step-up transformers from a 1,000-volt primary until an E. M. F. of 15,000 volts was reached. The insulation was not broken down under this high voltage.

In order to reduce to a minimum the danger of fires from silk or cotton covered lamp cords in show windows and similar places the company has perfected a Salamander lamp cord, similar to the Salamander conductors above named. This lamp cord is also efficient in the smaller connections of telephone switchboards.

The exhibition, as a whole, covers a very wide range of bare and insulated wires and cables. The Washburn & Moen company has long been known as the largest manufacturer of wires in the world, and with its large resources and unequalled facilities is capable of producing everything in the way of electric conductors.

There are employed by the company at their Worcester works in ordinary times over four thousand men, and at their Waukeegan (Ill.) works nearly one thousand more. Their insulating plant is installed in fine new buildings, and is under the superintendence of men of long practical experience. Many of the leading insulating concerns obtain their bare wire from the Washburn & Moen Manufacturing Company.

THE RUSSELL ENGINES.

One of the interesting exhibits of engines at the World's Fair is that of Russell & Co., of Massillon, O. The principal feature of this exhibit is a large double tandem compound engine. All four cylinders have Corliss exhaust valves operated by a positive eccentric, which also operates the main steam valves. The latter are flat multiported slides upon which the cut-off valves ride, operated by a variable eccentric in the shaft governor. The rods on both sides extend through both high and low pressure chests, and the governor controls all the cylinders. The crank-pin boxes are of cast iron babbitted. A countershaft is driven by this large engine, and to this are belted twelve Standard arc light dynamos.

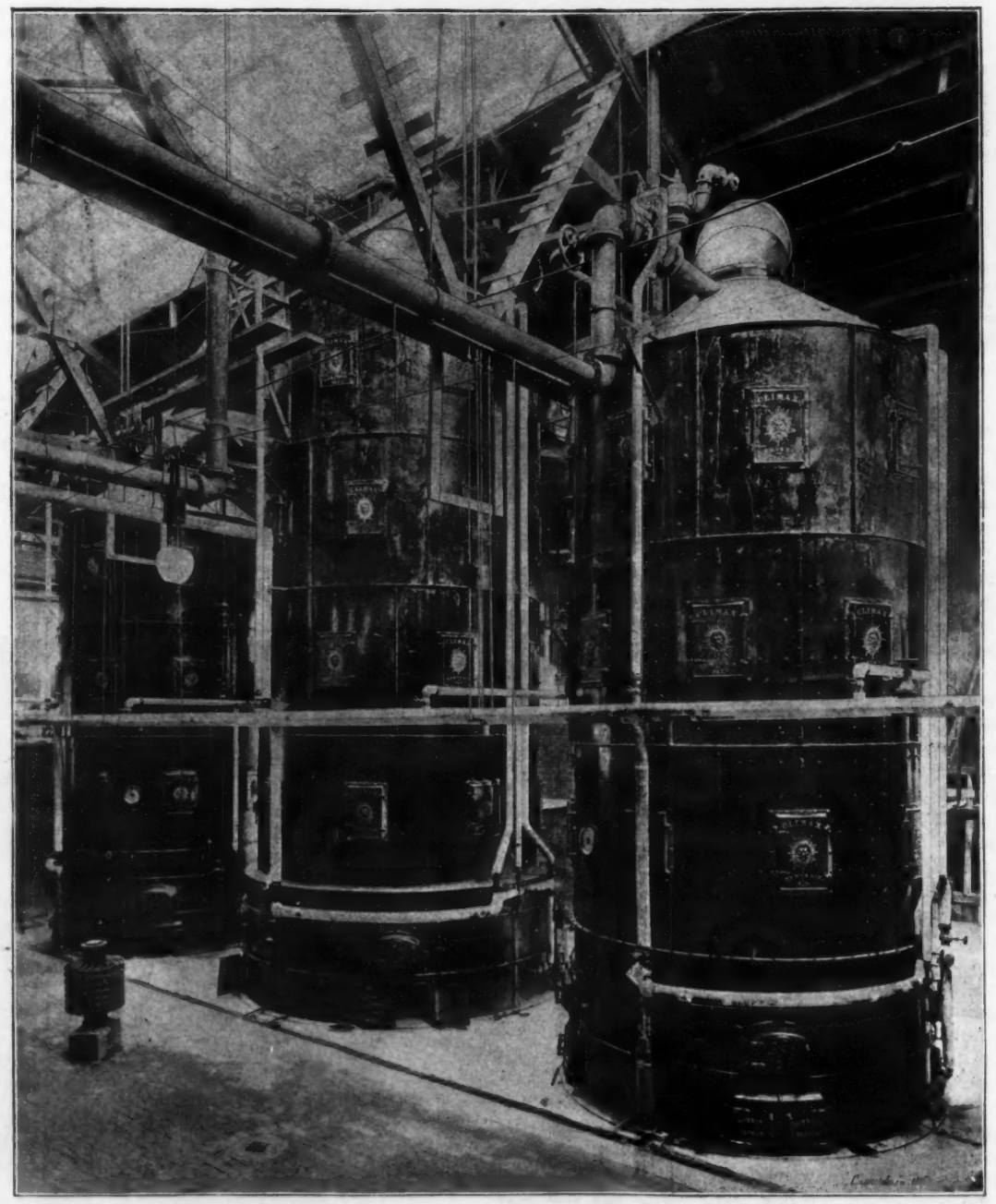
Russell & Co. have also on exhibition a 13 and 20½ by 20 tandem compound engine running at 160 revolutions and driving through a countershaft four arc light dynamos. Three simple high speed engines of smaller size are also shown driving the Western Electric Company's dynamos in the main plant, and one in the Libbey Glass Company's exhibit.

THE CLIMAX STEAM BOILER.

There can be no question that the exhibit of the "Climax" boiler made under the auspices of the Clonbrock Steam Boiler Works, of Brooklyn, N. Y., is one of the most interesting boiler displays in the immense battery which has been installed to furnish steam to the Exposition. These boilers are located in the annex of the boiler house and are three in number. The centre one is claimed to be the largest boiler ever constructed, having a capacity of 1,000 nominal h. p. It contains 1,000 tubes of 3-inch diameter by 12 feet long, which, if placed in one continuous line, would reach nearly two and a half miles. The heating surface is 10,000 square feet, and it is guaranteed to evaporate 15 tons of water into dry steam. On either side of the great centre boiler are two smaller ones of 500 h. p. each. A general description of the huge boiler may prove of interest.

The boiler has a main steel shell 54 inches in diameter by ⅞-inch thick, to which the tubes are connected, being expanded in the ordinary way. Each tube is bent into a spiral shape, the one end being 15 inches below the end of the other; this is to offer freedom for the circulation of the water which naturally rises as it is heated. Any of the tubes can be removed and replaced in about a couple of hours, without interfering with those adjacent to it. A manhole is provided at the top and bottom of the main shell to give access for cleaning or repairs. Within the main shell is a vertical cylinder which is about three-quarters of the height of the shell, extending to about the water line; it is open at the top, is built up in sections of light steel, and can easily and quickly be removed if necessary. It is subject to no strains, and is connected by small loose tubes to the lower ends of the boiler tubes. The feed water is delivered into the cylinder, toward the bottom, and as there is a difference in the temperature of the water within the cylinder, with which the lower ends of the boiler tubes have connection, and that in the annular space surrounding it, which is supplied by the upper ends of the boiler tubes, good circulation of the water is assured. The steam is thoroughly dried in the upper part of the boiler, above the water level. A coil is provided at the top of the boiler for heating the feed-water. The sediment naturally settles in the mud drum at the bottom of the shell and is blown off from time to time. The firebox is 15 feet 4 inches in diameter, with a bridge of firebricks which throws the flame well within the tubes and against the shell of the boiler. The casing of the boiler is built in 32 sections of light sheet iron with angle iron frames bolted to each other with firebrick lining. The upper part is conical and topped by a chimney, or flue leading to one. Each section has a cleaning door, and, if necessary for repairing, one or more sections can easily be removed. The grate is annular in form and may be stationary or rotary; if the former, four doors are necessary; if the latter, only one. In the World's Fair oil is used for fuel, but a stationary grate is provided so in case of a deficiency in oil supply or an accident to the oil apparatus the boiler within a few minutes would be using coal. Eight Larkin burners are fixed in the firebox above the grate, being so placed as to give the flame a rotary motion. The oil is introduced into the main chamber of the burner, which is kept at a high temperature by the steam which enters the annular chamber surrounding it. This chamber has a diaphragm which extends to within an inch or so of the nozzle end of the burner, so that the steam must travel to the front and back again before it enters the interior cylinder or chamber, which also has a diaphragm with an opening in the centre of it through which the nozzle of the oil pipe projects, leaving an annular space around it for the steam to pass through.

A recent test of a 500-h. p. Climax boiler was made at the plant of the Brush Electric Company, Baltimore, Md., at which some excellent results were obtained. It is claimed that 748.2 h. p. were developed under actual conditions, or 824.5 h. p. from and at 212 degrees, being an excess over the rated capacity of 64.8 per cent.; water evaporated per pound of combustible under actual conditions, 10.3 pounds; from and at 212 degrees, 14.65 pounds.

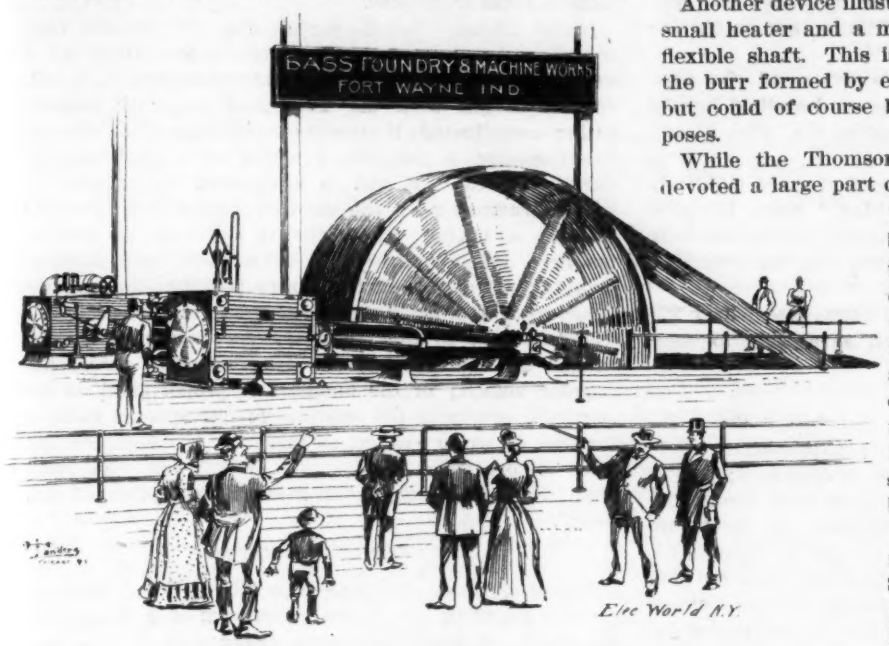


CLIMAX BOILERS AT THE WORLD'S FAIR.

A LARGE CORLISS ENGINE.

The Bass Foundry and Machine Works, of Fort Wayne, Ind., have on exhibition a cross-compound condensing Corliss engine, which has attracted considerable attention by its noiseless running and handsome appearance. The engine is rated at 300 h. p. at 125 pounds initial pressure and 70 revolutions per minute. The cylinders are 16 and 30 inches in diameter, with a 42-

inch stroke. The releasing mechanism operates so quietly as scarcely to be heard, and the dash pots make almost no noise and are not affected by various heights of lift. This engine was not built especially for exhibition, but is of the same design and finish as those sent out from the shops for commercial use, and therefore reflects all the more credit upon its manufacturers. The diameter of the flywheel is 16 feet, with a 42-inch face. The design, while heavy, is symmetrical. The guides are securely fastened together by a ring of metal at the forward end and directly over the centre foot carrying the strain from the top guide direct to the foundation. The guides are bored in order to secure



A LARGE CROSS COMPOUND CORLISS ENGINE.

alignment, and the end of the flange faced with the same bar, and at the same setting. The governor is of the Porter type, and the whole appearance of the engine is very attractive.

WELDING BY ELECTRICITY.

The Thomson Electric Welding Company, of Boston, Mass., has made a large and comprehensive exhibit in the Electricity Building, northwest section. The smaller types of machines are the only ones shown in actual operation, but it has been the aim of the company to show as great a variety as possible of special apparatus and a large number of various specimens of work done commercially by those using the machines throughout the United States.

Twelve machines of various forms are exhibited, arranged in such a way that three different kinds of plants are shown. The largest dynamo is of 60 kilowatts capacity, generating an alternating current of 500 volts. This is a constant potential, separately excited machine. Another dynamo is of 15 kilowatts capacity, generating an alternating current of 300 volts. The larger of these two dynamos is wired to a welder of universal pattern, which will weld steel or iron having a section to be welded of three square inches. The dynamo is connected to a switchboard, as used in ordinary practice. The smaller dynamo is connected to a universal welder, which is built to weld steel or iron having a section to be welded of 1.2 square inches and smaller sizes. This dynamo is also connected to the regular switchboard. Both of these welders illustrate the form of machine used where there may be a wide variety of work to be done. The machines are so designed that, by a simple changing of the clamping device, which can be very quickly accomplished, an infinite variety of welding can be done upon them.

In contrast to these two universal machines is shown a large pipe welder designed to weld heavy pipe 6 inches in diameter and other smaller sizes. In this machine are shown the special arrangements used by the Thomson Electric Welding Company for procuring a perfectly equal distribution of the electric current throughout the piece to be welded. Four transformers are connected in multiple, two above the piece to be welded and two below, feeding the current in through twelve contact blocks, six on either side of the weld. This has been found to be a very important step in forms of work where a wide, thin surface is to be welded. This pipe welder is operated almost entirely by hydraulic devices, and by repeated tests has shown an unusually high efficiency.

The second special welder is one designed for welding tires of a section 2½ inches by ¾ inch and smaller sizes. This is a machine similar to those used by many of the large wagon and carriage manufacturers throughout this country.

A plant for small welding is shown in operation. This consists of a 1,000-watt dynamo, self-excited, generating an alternating current of 300 volts. This is connected directly to a welder intended to weld ¼-inch rod and smaller sizes to No. 16 wire, and to a second welder for welding copper wire from No. 6 to No. 16 gauge. The dynamo is belted directly to a Thomson-Houston motor operated from a 220-volt circuit. This latter apparatus is operated regularly at the Fair, and has proved of great interest to those connected with all forms of metal working, as well as the public generally.

Electric forging is a matter to which the Thomson Welding Company, who were the first in the field in this work, and who own fundamental patents on the process. To illustrate this, an electric upsetting machine is shown, used at the works of Niles & Scott, of La Porte, Ind., where it has been in successful operation in upsetting the spokes in the rims of their agricultural wheels. The whole machine is automatic throughout, the spokes being clamped into position, the current turned on, the necessary upset given, and the current thrown off by the operation of the apparatus.

Another device illustrating electric forging consists of a small heater and a mechanical hammer, operated by a flexible shaft. This is especially designed for reducing the burr formed by electric welding on rods and wires, but could of course be used for regular swedging purposes.

While the Thomson Electric Welding Company has devoted a large part of its space to the exhibiting of its various forms of machines, it has been the intention to show in a thorough manner the various forms of work actually accomplished by the machines as performed in many industries throughout the country, and to render this possible many of the companies using these electric welders have furnished specimens of their work, which are shown to advantage on specimen boards in this exhibit.

Among those contributing specimens of wagon work are the Studebaker Manufacturing Company, of South Bend, Ind.; Haydock Brothers, of St. Louis, Mo.; Parry Manufacturing Company, of Indianapolis, Ind.; Kentucky Wagon Manufacturing Company, Louisville, Ky., and Schuttler & Holtz, of Chicago, Ill. These include axles, tires, hub bands, etc., of various sizes.

The New York Fifth Wheel Company, of Brooklyn, N. Y., has sent specimens of its anti-friction fifth wheels, in which a channel iron is bent edgewise into a circle, the ends being welded together. This illustrates a form of work, namely, the welding of channel iron, which can be easily accomplished by the electric process, which it is exceedingly difficult to do in the forge.

Specimens of pipe work, as used for ice machine and refrigerating purposes, are shown, in which many electric welds are made. Return bends are welded to various forms of couplings and flanges, straight pieces of pipe also welded to flanges and couplings and pieces of pipe welded directly to various forms of return bends made of cast steel, wrought steel and other forms impossible to weld by other means.

Welding, as done in carriage hardware, is illustrated by M. Seward & Sons, of New Haven, Conn., and the Cortland Forging Company, of Cortland, N. Y.

Specimens of steel and iron wire and rod welding are exhibited from the mills of the Washburn & Moen Manufacturing Company, of Worcester, Mass.; Carnegie Steel Company, of Beaver Falls, Pa.; Trenton Iron Company, of Trenton, N. J., and the Hazard Manufacturing Company, of Wilkes-Barre, Pa., the latter showing spring wire containing 60 per cent. to 80 per cent. carbon, which can be readily welded by a special process recently developed by the Thomson Electric Welding Company.

Copper welding is illustrated by specimens from the Benedict & Burnham Manufacturing Company, of Waterbury, Conn., and the Tamarack-Osceola Copper Manufacturing Company, of Dollar Bay, Mich., who show copper rods ⅜-inch in diameter, containing eight welds, drawn down to No. 16 wire without any breaks occurring in the weld; also ¼-inch rod drawn down to about No. 30 wire without any defective welds.

Among other specimens of interest are those furnished by E. C. Atkins & Co., Indianapolis, Ind.; Richmond Cedar Works, Richmond, Va., and the General Electric Company, of Lynn, Mass.

Specimens of welds are shown in aluminium, lead, brass, copper and other metals impossible to weld by any other process; 2½-inch steel bars have been welded and tested on the Emery testing machine at the Government Arsenal at Watertown, Mass., all the breaks occurring outside of the weld after a total load of upward of 309,000 pounds had been applied.

Besides these specimen boards described are shown many forms of large welds, the largest collection being furnished by the Johnson Company, of Johnstown, Pa. Several of the specimens shown by this company have a total cross section welded of over 12 square inches, one piece having a welded area of 24 square inches.

THE CHAPMAN VALVES.

In Section K 28, Machinery Hall, may be found the exhibit of the Chapman Valve Manufacturing Company, of Indian Orchard, Mass., which comprises almost every variety of valves in commercial use at the present day. This well known company has recognized the modern tendency to increase the steam pressure by designing a complete line of valves and flanges with a corresponding increase of strength. The Chapman high pressure steam valve, with its improvements, is one of the special features of display. This valve has renewable bronze seats and a self-packing spindle, by means of which the valve may be packed when wide open with steam on the line. The ribbing of the body so that it is not affected by the expansion of the pipe line, the outside screw and yoke, which acts as an indicator, and a by-pass arrangement, are also interesting points in the construction of this valve. The valves shown are plain, and tongued and curved, and may be used bolted to the flange or as flange unions. This company also shows in actual operation high pressure steam valves on the E. P. Allis quadruplex expansion engine in Machinery Hall, and on the Heine boilers in the annex, and in the power house of the Intramural Electric Railroad, the latter being fitted throughout with both high and low pressure Chapman valves. A complete line of brass and iron flanges is also shown, which are adapted to feed and circulating systems and exhaust and low pressure steam, together with ammonia valves for refrigerating purposes and valves and hydrants for use on cast iron pipes. The exhibit is in charge of Mr. Edward L. Ross, who looks after the interests of the company in a most satisfactory manner.

A FINE DISPLAY OF CHAPMAN VALVES.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO PHYSICS.

Piezo-Electric Property of Quartz.—A paper by Lord Kelvin read at the recent B. A. meeting on this subject is reprinted in full in the Lond. "Elec. Rev.," Sept. 22, accompanied by a number of diagrams; in it he offers an explanation of this phenomenon; the paper belongs more to the domain of theoretical physics. (This phenomenon is briefly as follows: A plate of quartz is ground to a thin rectangular bar, whose faces are perpendicular to the binary axes of the crystal; if then a tensile force tending to stretch the same is inserted in the direction of its length, that is perpendicular to the optical and to the electrical axes, the two opposite faces, which are silvered to make them conductive, will become oppositely electrified, the quantity of electricity being strictly proportional to the variation of the tensile strength; on the cessation of the mechanical stress the electrification will be reversed as regards a sign; the dimensions parallel to the optical axis have no influence on the amount of electricity set free.)

Piezo-Electric Pile.—A paper by Lord Kelvin read at the recent B. A. meeting is reprinted in the Lond. "Elec. Rev.," Sept. 22, and in abstract in the Lond. "Elec. Eng."; the pile is based on the phenomenon described in the above paragraph; it consists of 24 double plates eight centimetres square, of zinc and copper soldered together, zinc on one side and copper on the other; half a square centimetre is cut from each corner of each zinc plate, leaving the copper uncovered at the four corners; a pile of these plates is made resting one over the other on four pieces of india-rubber at the four upper corners, leaving an air space between the plates of several millimetres; the upper and lower plates are connected to an electronometer, the lower one being earthed; when a weight of a few decigrams or kilograms falls from a height of a few millimetres on to the upper plate and remains there "a startlingly great deflection" is obtained; if the zinc face is uppermost it will be positive.

Mechanical Effect of Rapid Oscillations.—Mr. Bleekrode, in the Lond. "Elec. Rev.," Sept. 8, describes an effect observed more than half a century ago, but repeated now with more modern apparatus. The usual arrangement, slightly modified, for producing rapid oscillations was used, consisting of a step-up transformer (a Ruhmkorff coil), the secondary of which charged a Leyden jar through a circuit containing a spark gap; the Leyden jar was shunted by a spiral of one-quarter inch iron wire of 12 turns, and this was again shunted by a very thin platinum wire .07 millimetre in diameter and 15 centimetres in length; the researches relate to the behavior of this thin wire; it vibrates over its whole length, particularly when heated by the current to a red heat; it is frequently broken by the oscillations, at the ends; inflections of a peculiar character and size (somewhat like saw-teeth) are produced on the surface of the wire; they are of some regularity, and appear as if made with an edge-shaped instrument (although not stated, it appears that this change of the wire is permanent); cuts of certain specimens are given, but they are too indistinct to be reproduced here. Referring to the incandescent lamp in the experiments of d'Arsonval and Swinburne, through which high frequency discharges are sent, he states that it always rapidly deteriorates, numerous carbon particles being pulled away at the points where the filaments join the platinum, until the lamp is broken; Becquerel, in 1837, and Riess, in 1845, made similar experiments with wires, stating that the diameter increased, and the length shortened (a fact easily explained by the above experiments). In conclusion Dr. Bleekrode says that it appears to him rather difficult to reconcile with the above described facts the theory that the current is traveling in a skin-deep layer only, which, according to Prof. J. Thompson, is .005 millimetre in depth.

Luminous Discharges.—In "La Lum. Elec.," July 15, Mr. Blondin shows how the luminous phenomena observed under different experimental conditions can be explained theoretically; he discusses the experiments of Rimington, in which discharges are produced in electrodeless tubes containing rarefied gases, and shows how the best dimensions of the different parts of the apparatus may be determined by calculation.

Residual Charges.—"La Lum. Elec.," Sept. 16, publishes a paper translated from the Italian of Mr. Dessau, in which he discusses the experiments which tend to show that there is no residual charge when the material is homogeneous, and describes more recent researches made by himself with palmitic acid and with paraffine, with both of which he finds residual charges.

Theory of Light.—The Lond. "Elec. Eng.," Sept. 15, reprints in full, and the Lond. "Elec.," Sept. 15, in abstract, the presidential address of Mr. Glazebrook before the British Association; the greater part is devoted to the history of the undulatory theory of light, concluding with a few paragraphs concerning the electrical aspect of the subject. In the first portion he gives a brief summary of the events of the past year concerning the mathematical and physical section of the Association.

Electro-Magnetic Theory of Light.—Mr. Raveau continues his series in "La Lum. Elec.," Sept 23, in which he discusses the theory of dispersion.

Electricity Produced by Contact.—The "Elek. Zeit.," Sept. 15, abstracts from the "Weid. Ann.," vol. 50, p. 147, an article by Mr. Holz, showing how electricity may be generated by dropping mercury on glass plates; his experiments prove the statements made by von Helmholtz, that in so-called friction machines the generation depends, not only on the friction, but on the intimacy of contact of the two bodies.

Influence Machines.—A full description of the new machines of Wimshurst and Pidgeon, described briefly in the Digest July 22, will be found in the "Phil. Mag." for September.

Formulæ of Coulomb, Laplace and Ampere.—"L'Ind. Elec.," Aug. 25, and "La Lum. Elec.," Sept. 16, give an abstract of a note by Mr. Amagat on the relation which exists between the coefficients and the formulae of Coulomb, Laplace and Ampere.

Conservation of Energy.—In "La Lum. Elec.," July 22, Mr. Blondin discusses this subject, as applied to electrical phenomena.

MAGNETISM.

Commercial Magnetism.—"Ind. and Iron," Sept. 15, publishes another editorial under this inappropriate heading; the idea of magnetic potential is discussed; potential, it is claimed, is exactly analogous with level, and difference of potential with a difference of level; an attempt is made to give a clear insight into this subject; in conclusion it states "we thus arrive at the important result that if a pole is allowed to move along in a path interlocked with a current circuit, the work done on it by the electrical system is 4π times the current." In the issue of Sept. 22, the editorial starts with the statement "if a unit pole started from a given point and following a path interlinked with an electric current, returned to the position from which it started, it did work and fell in potential by an amount equal to 0.4π times the ampere turns in the circuit"; it then attempts to explain the weak point in the "level" analogy (using, however, the difficultly conceivable idea of a single unit pole without reference to a corresponding pole of opposite polarity); in conclusion he states that "instead of considering that in a magnetic or electric circuit the unit pole or charge is pushed round a level path by externally supplied energy, we will say that, magnetically, it falls as if the path were a spiral, so that the potential of a point in cases of cyclosis has an indefinite number of values."

Magnetic Expansion of Iron.—The "Jour. of the Inst. of Elec. Eng.," for July, contains an abstract from the "Jour. de Phy.," for July, of a paper by Mr. Berget, in which he measured the expansion of iron at different degrees of magnetization by the Fizeau method, based on the interference of two reflected waves on the two faces of a thin layer of air; a series of values is given, but as absolute values they are of little use, as the units are not given; the curve for these values resembles the usual curve connecting B and H.

Earth's Magnetism.—The "Elek. Zeit.," Sept. 15, gives a brief resume of recent tests made in Switzerland.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Resistance of Earth Connections.—Dr. Kallmann, in the "Elek. Zeit.," Sept. 22, describes, in a lengthy article, several methods for measuring the resistance of earth connections; that is, the insulation resistances, in electric lighting circuits; he calls attention to the unreliability of Wheatstone bridge methods with low voltages, and recommends the use of ampere or volt meters, together with the voltage existing on the line. The explanation and the diagrams are not very clear, but one of the methods, which is quite simple, appears to be as follows: Connect, say, the positive wire, in series with an adjustable resistance and an ammeter, to earth and note the current, which will be $C = \frac{E}{r}$ in which r is the adjustable resistance; then disconnect the earth contact and connect with the neutral wire, the current in the ammeter will then be $c = \frac{E}{R + r}$ in which R is the insulation resistance or the contact resistance of the neutral wire from the earth (the article states that it is the total insulation resistance of the whole network); the value of R, in ohms, is, therefore $R = E\left(\frac{1}{c} - \frac{1}{C}\right)$ It is better, if possible, to use a separate dynamo insulated from the circuits; the best resistance of r is to make it approximately equal to R; the resistance r could also be regulated in the two cases so as to maintain the current the same in both, the change in its resistance is then equal to R. The same method can be applied for measuring the insulation resistance of junction boxes, railroad return circuits, etc. He also describes another more complicated method, the explanation and diagrams for which are, however, not as clear as might be desired.

Lecture Apparatus for Showing Induction.—The "Elek. Zeit.," Sept. 15, mentions an apparatus called a "dicykel," for showing the laws of induction; it appears to consist of two pointers, one showing the inducing current and the other the induced current; when, for instance, the first moves to the right, the other will move to the left, and vice versa, while if the first shows a continuous current, the second will point to zero, etc. The description is taken from "Wied. Ann.," vol. 49, No. 8.

Preservation of Standards.—Mr. Guillaume, in "L'Ind. Elec.," Aug. 10, contributes an article on this subject, in which he points out the importance of being able to verify concrete standards, or to define standards in such a way that they may be readily reproduced, thus maintaining them invariable.

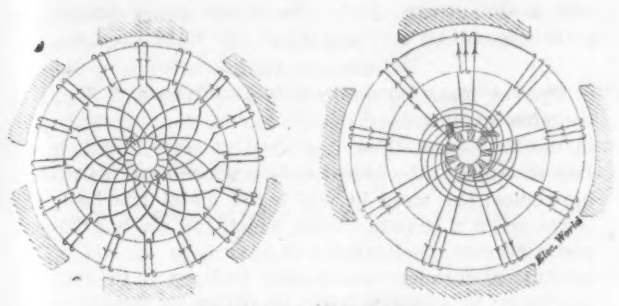
Brillié Meter.—"L'Ind. Elec.," Aug. 10, gives a very complete description of this meter, accompanied by a number of cuts, including an illustration of each detail. In comparison with the Thompson meter it appears rather complicated; it consists essentially of an electrodynamometer, a damper, a motor with rheostats for varying its velocity, and an integrator; the principle is that a wattmeter on the electrodynamometer principle deflects a copper disc situated between permanent magnets which are revolved by a motor and gearing, bringing the disc back to its zero position; the angular velocity of the magnets is regulated automatically at every instant, so that the eddy currents produced establish an equilibrium with the deflecting force; the angular velocity of the magnets is proportional to the electrical energy in the wattmeter; this appears to be a favorite meter in France, as there are at present about 2,000 in use. The Lond. "Elec. Rev." and "Ind. and Iron," Sept. 22, also publish a short description of this meter.

DYNAMOS AND MOTORS.

Non-synchronous Motors.—The "Elek. Zeit.," Sept. 8, gives a paper by Dr. Behn-Eschenburg of a theoretical discussion of non-synchronous alternating current motors. He includes the three types of motors which have shown themselves to be commercial; the first is the multiphase motor; second, the single-phase motor with short-circuited armature, but without commutator and brushes; and third, the single-phase motor whose armature is short-circuited through a commutator and brushes. He deduces formulas for calculating the different properties; unlike in most articles of a theoretical nature, a number of practical conclusions are drawn, many of which, however, cannot be given here without the formulas themselves. Among his conclusions the following may be of interest: Multiphase as well as single-phase motors are in every respect completely analogous to transformers, and one of the first rules of their construction is that a good motor should, in every way, be a good transformer; the energy required by a multiphase motor when running without load is equal to the so-called magnetizing energy in a transformer; in the first form of single-phase motor, however, this energy will be twice as great as the magnetizing current on open circuit; in both, when running without a load, the current is almost independent of the dimensions of the conductors; it may be accepted as a general rule for the construction of efficient motors that the difference between the current at no load and the maximum current when at rest should be as great as possible, as on this depends the tendency to remain almost in synchronism; the armature windings should, furthermore, have great self-induction and a low resistance; this applies, in the case of single-phase motors, only when the armature system contains more than one closed circuit, allowing currents of different phases to circulate, for if there is only one circuit, both the multiphase and the single-phase motor will have a maximum torque at half of the synchronous speed, and the motor will, therefore, not be able to exceed this speed; there should be no position of the armature in which the torque is less than in another, or a braking action will ensue; projections on the polar surfaces producing such irregularities should therefore be avoided; the number of holes or channels in the armature and in the field should therefore be incommensurable with each other; the windings on the armature should be such that the induced currents of different phases should be independent of each other. He develops a formula for the torque from which he deduces a number of important practical conclusions; he develops briefly a theory of series and shunt motors of these types showing their difference; from which he concludes that series motors will give little satisfaction; in conclusion he gives the equations for the third class of motor; one of the chief conditions in the latter is that the resistance should be exceedingly small in comparison to the coefficient of induction. In general, he states that the calculation of motors is based on equally simple formulas as that of transformers.

Alternator Without Self-Induction.—Under this heading Mr. Guilbert in "La Lum. Elec.," July 15, describes one of the numerous inventions of Messrs. Hutin and Leblanc; it appears to consist of using, in connection with the alternator, the usual form of commutator for continuous current machines, and placing in series with each coil another coil which is intended to balance it as far as self-induction is concerned. He also describes a transformer which is reversible, for transforming a simple alternating current into two or more currents of different phases.

Armature Windings.—Mr. Rosenkranz, in the "Elek. Zeit.," Sept. 22, refers to the winding recently suggested by Mr. Baumgardt, illustrated and described in the Digest July 15, and shows that it is not new, it having been described in a book on armature windings by Mr. Arnold, published in 1891. In this connection he also illustrates the two windings shown in the adjoining cuts, also suggested by Mr. Arnold; like the



ARMATURE WINDINGS.

other, they are specially adapted for large machines of high voltage; the first one, he says, is probably the best and simplest series winding for multipolar ring armatures; in the second the wires may be arranged so that there are no crossings; practice is said to have shown this to be a very good winding.

Balancing Armatures.—In a paper by Mr. Beaumont, read at the recent B. A. meeting, and reprinted in abstract in "Ind. and Iron," Sept. 22, he calls attention to the fact that an armature may appear to be balanced mechanically when it is tested in the usual way by resting its shaft on two horizontal knife edges, but that it may then nevertheless be out of balance when revolving, as there may be an excess of weight at two diametrically opposite parts near opposite ends of the shaft; to test this he suggests revolving the armature round a motor coupled to it by a light flexible shaft, the temporary bearings of the armature being hung on chains; if it is not dynamically balanced it will soon begin to vibrate. (This method is not new, as it was described by the compiler in his book on dynamos, page 64.)

ARC AND INCANDESCENT LIGHTS.

Researches with Alternating Current Arcs.—Mr Blondel, in "La Lum. Elec.," Sept. 16, gives the first part of an article describing the methods, apparatus and results in a long series of researches with alternating current arcs, giving the periodic curves of a large number of different arcs under different conditions, in order to show the part which the different variables take in the behavior of the arc; in the present installment he describes the experiments and the apparatus. In the issue of Sept. 23 he gives some of the results of his very extended research, including several tables and 24 sets of curves for arcs under different conditions, each set containing three curves, one giving the E. M. F. induced in the machine; the second, the difference of potential at the ends of the carbons, and the third, the current, all three being for one complete period; the text embodies a description of the tests and the deductions from the results; the article does not admit of being abstracted; it is to be continued; it forms probably the best set of researches made with alternating current arcs.

Light and Heat of the Arc.—The "Bul. de la Soc. Int." for June contains a paper by Mr. Violle, in which he describes a number of researches with the arc, the results of which have already been noticed in these columns; he shows that the light and heat of the arc remain constant, being independent of the current of the voltage; he describes and illustrates the apparatus for measuring the temperature of the arc, in which a small button of carbon, forming the end of the positive pole, is detached after being heated and falls into a calorimefer directly below it; he thus found the temperature to be 3,500 degrees C.

Dense Carbon.—The "Phil. Mag." for September gives a paper by Mr. Parsons in which he describes experiments intended to produce a hard dense carbon for arc, as well as for incandescent lamps; the carbon rod was heated by an electric current while under great pressure; when surrounded by a liquid, like benzine, bisulphide of carbon, etc., on which the pressure was exerted, the results were unsatisfactory, there being a soft black deposit produced on the carbon, and the density of the carbon was not increased; when the rod was placed in silver sand under a pressure of from 5 to 30 tons per square inch, and a current of 300 amperes passed for a rod about ¼ inch in diameter, the carbon was changed to graphite, its density being considerably increased; the carbon was thereby consolidated by about 30 per cent.; it was about as hard as the densest retort carbon. Under other conditions a deposit was produced which was either true diamond dust or a substance which could not be distinguished from it.

Portable Lamp.—The Lond. "Elec. Eng.," Sept. 22, mentions a portable miner's lamp, 2¾ inches square, 8 inches high, and weighing 3½ pounds, giving "a light" for 16 hours; all that is said of its intensity is that it is brighter than the best modern safety oil lamp. The same journal states that the Edison & Swan Company makes a portable accumulator battery and lamp weighing seven pounds which will give a light of one c. p. for 10 hours.

Reduction in the Price of Incandescent Lamps.—The Lond. "Elec. Eng.," Sept. 22, states that the Edison & Swan Company in England have just reduced the price of their lamps from 3s. 9d. to 1s. 9d. (or about 43 cents), a reduction of more than one-half; this action was taken in anticipation of the expiration of their fundamental patents in November.

Small Incandescent Lamps.—The Lond. "Elec. Rev.," Sept. 22, calls attention to the lavish use of 16-c. p. lamps in many places where an 8 or a 5-c. p. lamp would give all the light required.

Incandescent Lamp Manufacture.—In Mr. Ram's serial in the Lond. "Elec.," Sept. 15, he describes the sealing-in and the exhausting processes.

Arc Lamp.—The new lamp of Messrs. Koerting and Mathiesen is described and illustrated in the Lond. "Elec. Rev.," Sept. 15.

TRANSMISSION OF POWER.

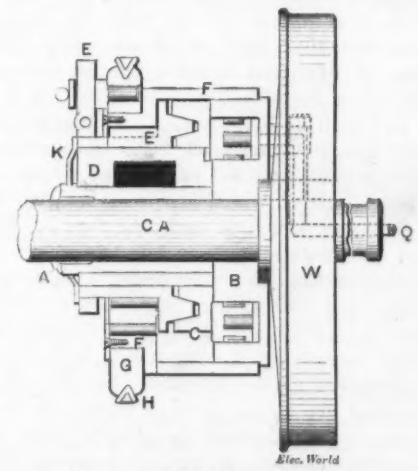
Transmission of Power.—The Lond. "Elec. Eng.," Sept. 15, reprints the first part of the first Howard lecture delivered before the Society of Arts by Prof. Unwin on the development and transmission of power from central stations; the present portion deals almost exclusively with mechanical power; he states that "there may be some advantage in approaching the subject with the bias of an engineer rather than of an electrician"; he thinks there is a popular tendency to regard too exclusively the electrical method and to overlook other means; he admits that striking success has been achieved by electrical transmissions of power, but states that there are other methods more convenient and less costly in some cases; he admits that there are advantages in electrical transmission for great distances, but that such cases are rare; regarding the Frankfort-Lauffen experiment, he states that the cost of the power at Frankfort was five times as great as it would have been if generated directly in Frankfort by a steam engine. After stating the well known advantages of generating power at central stations, he gives some figures of the hydraulic plants in London and Geneva, making the broad assertion, "in no instance has the use of hydraulic power, when once adopted, been abandoned in favor of any other system of working hoisting machinery." (Without indorsing this broad statement, we call attention to the fact that in many new installations electric power has been adopted in preference to hydraulic, while in still more cases it has been adopted where hydraulic power would never have received a moment's consideration.) In discussing the sources of mechanical energy, he states in connection with the subject of solid fuel, that one-fifth to one-fourth of the heat escapes in the chimney; that at most three-eighths to four-fifths of the heat supplied to a steam engine can be transformed, and that three-tenths of the whole heat of the fuel which it is possible to transform by the steam engine, is further reduced by imperfections and losses in the engine itself; in connection with gaseous fuel he mentions the advantages of gas engines, including the fact that they have a higher efficiency than steam engines; gas for heating and power purposes he states will probably be distributed and sold at less than half the price of the present gas; regarding town refuse, as a fuel, he states that Mr. Watson calculates that in furnaces at Leeds 4,800 pounds of water can be evaporated by the heat produced by a ton of refuse, but he discredits these figures; from the experiments at Oldham it appears that 40 pounds of refuse will yield an effective horse-power hour. The second portion of his lecture is published in the issue of Sept. 22; this portion is devoted to the generation of power by steam and the conditions of economy and waste; some interesting tables of results, diagrams and curves are given.

Relative Cost of Conductors.—The Lond. "Elec. Rev." and "Elec. Eng.," Sept. 22, reprint in full a short but interesting paper by Mr. Kapp, read at the recent B. A. meeting. In an alternating current circuit of 10,000 effective volts, he states that the greatest potential difference between two points will be 14,000, and the greatest possible value of the absolute potential, 7,000 volts, positive or negative; the insulation to earth will, therefore, be put under a stress not exceeding 7,000 volts; but if one point on the line is earthed the stress at every point will immediately rise to 14,000 volts. He then compares the weight of copper required for the line in different systems, assuming the same total power, the same efficiency, and the greatest permissible stress from the earth as 7,600 volts; the effective voltage for alternating currents will then be 10,000 volts, and for continuous currents, 14,000 volts, and since the weights of copper vary inversely as the square of the voltage it follows that the transmission of power with alternating currents requires twice as much copper as with continuous currents; the same is true with two-phase alternating currents run with four wires; if, however, two of these are bunched that wire carries about 70 per cent. of the current, but it is a fallacy to asume that there is, therefore, a saving of copper, as there will actually be required more copper than with a single-phase system, or a four-wire, double-phase system, the reason being that the electrical centre of gravity of each circuit will be displaced, causing the potential of the other terminals to vary between wide limits; for the same limit of stress the voltage must, therefore, be lowered, which means more copper; similarly, the voltage in a three-phase system must be lower than with a continuous current, but it may be higher than with a single-phase current; the mathematical investigations are not given. In conclusion, he states that for the same efficiency of safety of insulation he finds the following: If 100 tons of copper are required in a line for continuous current, then 200 tons will be required for the single and for the two-phase four-wire system, 290 tons for the two-phase three-wire system, and 150 tons for the three-phase three-wire system; as far as the line is concerned, there is thus a distinct advantage in the employment of the three-phase system. (For continuous current Mr. Kapp appears to assume that the voltage is constant; this is aproximately true of machines with many commutator bars, but it is not true for machines like the Brush or the Thomson-Houston arc light machines, and therefore his results do not appear to apply to continuous currents generated by these machines.)

Utilization of Water Power.—The Lond. "Elec. Rev." and "Elec. Eng.," Sept. 22, publish a paper by Mr. Snell, read at the recent British Association meeting, on the utilization of waste water power by electricity. He calls attention to the fact that little use is made in Great Britain of water power for generating electricity, and he describes briefly a few Continental plants, including those at Feurstenfeld-Bruck, Tivoli, Lauffen-Heilbronn, Genoa, Cassel, and at the Greenside silver lead mine in Great Britain, all of which have been already described in the journals.

ELECTRIC RAILWAYS.

Variable Speed Gearing.—The Lond. "Elec. Rev.," and "Elec. Eng.," Sept. 22, publish a paper by Mr. Beaumont, read at the recent British Association meeting, describing his new form of gearing for railway motors, the object of which is to enable a motor to be used with a single reduction gearing for starting, and as a gearless motor, after starting; in the South London Railway it is claimed that the power at starting is from 25 to 60 per cent. greater than that required to keep the train going; Mr. Greathead, the engineer of that railway, has stated that if this could be avoided, from 20 to 30 per cent. of the engine power might be saved. The motor is placed directly on the axle, but is much smaller; it is on a hollow spindle, and at starting it drives through a double clutch containing a pair of epicycloidal reducing gears, the clutches being operated by electromagnets, or by fluids under pressure. The device is described as follows, reference being made to the



VARIABLE SPEED GEARING.

adjoining cut: "In Fig. 1 the gearing is shown as operated by fluid pressure, and arranged as for a locomotive for direct driving. On the axle *C A* is fixed a disc *B* containing an annular cylinder, or rather chamber, in which is an annular piston *P*, which, by admission of oil under pressure, or air from the continuous brake cylinders, is caused to press, when necessary, against gripping ring *C*. On the end of the motor shaft *A* is fixed an eccentric *D*, which gives a gyrating motion to the toothed ring *E*. This correspondingly gives motion at a slow rate to the gear ring *F*, which is fixed to the disc *B*. Upon a projecting part of the internal gear ring is a bridle with an arm *E*. This arm is free to slide in a bridle *O*, pivoted in a ring *G*. The ring *G* is either to run free, or is held fast by parts which constitute a brake clutch, of which only the ring *H* and levers *L* are seen. When it is desired to start a train, the ring *G* is held fast by this apparatus, and *O* becomes a fulcrum, about which *E*, with the ring *E*, gyrates. The locomotive axle is then driven by the wheel or ring *F* at one-fifth of the speed of the motor, or a power ratio of 5 to 1. This is required for a few seconds at each start. The inertia of rest of the train having been overcome, the ring *G* is set free, and fluid under pressure admitted at *Q*, thus pressing the ring *C* upon *E*. This fixes the whole of the working parts of the gear, and couples the motor shaft and locomotive axle, so that the latter is direct driven. The motor can thus run idle, driving nothing, or it may drive the axle at one-fifth of its speed, or at its own speed. When running at normal speed, the whole of the gear described runs as one solid piece, and only works for starting a train or getting up hill. A breakdown would leave the locomo-

tive in the condition of a gearless engine." A similar device is also shown for converting the usual single reduction gearing into one with double reduction, while starting.

Brussels Underground Road.—The "Bul. Elec. Montefiore" for June and July publishes a letter from Mr. Greathead, the consulting engineer of that line. Besides the data already given in The Electrical World, Sept. 2, p. 183, and in the Digest, Sept. 23, the following may be of interest: The voltage will be 500; the elevators will be operated electrically and have a capacity of 40 persons; there will be two at each station; the conducting rail weighs about 10 pounds per yard, and is placed on glass insulators at intervals of 7 feet; the rails weigh 70 pounds per yard; for a number of reasons it is preferred to use locomotives instead of having the motors on the cars, one reason being that repairs are more easily made, and while they are being made the cars are not out of service; each locomotive will have two gearless motors of 50 h. p.; the trains will be furnished with Westinghouse air brakes; the cars will be lighted with electric lamps; the cars will have an aisle through the centre, as in this country. A short description is given of the method of boring the tunnel, which is similar to the method used in London; the article concludes with a long list of advantages of such a road, both to the company and to the passengers, over those of surface or elevated roads.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Train Lighting.—"La Lum. Elec.," Sept. 16, continues its serial on this subject (see Digest last week); the present section treats of lighting by means of accumulators charged at stations; and it describes in detail the installation on the Paris-Lille line; 16 cells are used per car, two of which are kept as reserves; what is known in this country as the "chloride accumulator" is used; the total weight is 858 pounds, the capacity being 121 ampere-hours; four lamps of eight c. p. are used in each first class car; the life of the lamps is 300 hours, but after 200 hours they are removed to the baggage car; the total cost of the complete outfit for one car is $145, of which $92 is for the accumulators; it has been found during the past year that one charge will run the lamps for 35 hours, but only 30 are counted upon; the cost of the charge, the maintenance of the accumulators and the renewal of the lamps is .42 cent per lamp-hour, the interest and amortization .09, the attendance .07, making a total of .58 cent per lamp-hour. It also describes the installation of the 50 first-class cars of the Paris-Lyons-Mediterranean line; an Aubert meter is used, indicating the amount of the discharge; at a certain reading of this meter, a rheostat which was in series with the lamps is cut out; there are two lamps arranged so that when one is used up the other is lighted automatically; there is also a reserve oil lamp. In the issue of Sept. 23, detailed figures, taken from a number of other installations, are given; on a line in Germany in which de Khotinsky accumulators are used, the battery has a capacity of 112.5 ampere-hours and 16 volts, weighing about 600 pounds; every car contains three batteries, one of which is a reserve; two batteries run eight lamps of four c. p. each and four of two c. p.; the cost of the installation per lamp is about $40. On the Jura-Simplon line, in Switzerland, a battery weighs 242 pounds, each containing nine cells of Huber accumulators; the light is about 30 to 35 candles for about 20 hours per charge; an Aubert meter indicates the degree of exhaustion of the accumulators; the figures for this installation are given quite in detail, the total cost of operating per candle-hour being 0.07 cent, which is based on actual results. A French company has been experimenting with de Meritens' primary batteries; a battery weighing 264 pounds will light three lamps of 8 c. p. for about 48 hours, the cost being 0.172 cent per candle hour. Comparative figures are given, presumably taken from actual tests, for oil, petroleum, gas, primary batteries and accumulators, which show that with the latter one and one-half times as much light can be obtained for the same price as with oil lamps.

Power from Town Refuse.—Mr. Tomlinson's article mentioned in the Digest, Sept. 16, is continued in the Lond. "Elec. Rev.," Sept. 15. This portion is devoted to a description, including data, of some tests made with a destructor.

Distribution.—Mr. Guy, in his serial in the Lond. "Elec. Eng.," Sept. 15, discusses the system of distribution for low pressure currents, including the feeder and the three-wire systems; it contains nothing new.

Central Stations.—Under the heading of "Electrical Supply Companies," the Lond. "Elec. Eng.," Sept. 22, begins a series of articles intended to deal with the history during the last year or two of the central stations in London and other large English towns, to describe, with some technical detail, the plant and working of the stations, and to give the cost of generation and distribution. The first station described is that of the Westminster Company in London.

Sao Carlos Do Pinhal.—The London "Elec. Rev.," Sept. 15, gives a brief description of the central station in this town, which is said to be the first town in Brazil depending entirely upon electricity for its light; water power is used to drive alternators, the power house being 2½ miles from the town; the machinery used is English.

Vevey Montreux.—"L'Ind. Elec.," Sept. 10, gives an illustrated description of this Swiss station, embodying, however, nothing of particular interest.

Hanover.—"L'Ind. Elec.," Aug. 25, gives an illustrated description of this station, though not as complete as the one recently mentioned in these columns.

Glasgow.—The Lond. "Elec. Rev.," Sept. 22, gives a brief description of this station.

Locle.—"L'Ind. Elec.," Aug. 10, gives the balance sheets of the station at Locle.

Valveless High Speed Engine.—The Lond. "Elec. Eng.," Sept. 22, describes and illustrates a curious form of steam engine for small powers recently introduced in London, which contains no steam chest, valves, eccentric, connecting rods and no stuffing boxes, or packing of any kind; it is single acting and compound; the pistons act as their own steam valves, and can be arranged to cut off at any part of the stroke, thus working with any degree of expansion; figures are given for a 5-h. p. engine, showing a mechanical efficiency of 93.6 per cent., and a consumption of 33.8 pounds of feed water per brake h. p.-hour.

Gas Engine Starter.—The Lond. "Elec. Rev.," Sept. 15, describes briefly and illustrates an arrangement consisting of a hand lever, gripping the end of the main shaft with a friction clutch working one way only, which does away with the dangerous practice of starting an engine by the flywheel.

Gas and Hydraulic Engines for Electric Lighting.—The "Bul. Elec. Montefiore" for June and July contains a paper by Mr. Bourquin, in which he describes the advantages of gas engines for central stations; he also criticises unfavorably the Van Rysselberghe system mentioned in the Digest last week.

WIRES, WIRING AND CONDUITS.

India-Rubber Insulation.—In an editorial on this subject the Lond. "Elec. Rev.," Sept. 22, calls attention to the future of india-rubber as a competitor of gutta-percha for insulating submarine cables; the supply of gutta-percha, unlike that of india-rubber, is limited, and it is therefore thought that something will have to be found to supersede gutta-percha; the most promising substance is stated to be india-rubber; the article states that it has been amply proved by facts that india-rubber can be depended upon; its high insulation and its nature render the detection of faults of manufacture more easy and certain than with gutta-percha; if a cable passed the manufacturers' tests, it is claimed that it can be relied upon absolutely not to develop faults when laid; it can bear without injury a high temperature, which is important in its use in hot climates; the process of jointing is easy and certain and does not require so much skill; unless well protected, however, rubber is not suitable for conditions of alternate dry and wet. An article in another portion of the paper describes and gives illustrations of faults which have developed in an india-rubber cable made by Mr. Hooper, intending to show that these faults are due to other causes than properties of the insulating material.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Effect of a Grounded Neutral on Telephone Circuits.—In order to show that the grounded neutral of lighting circuits interferes with telephone circuits Mr. Grawinkel, in the "Elek. Zeit.," Sept. 22, gives the results of some measurements which tend to show that the test to find whether a line is in use or not is hindered or is made impossible if there is a grounded neutral wire in that city. Tests were made in Altona, where an uninsulated neutral wire is used, and in Hamburg, where the electric lighting circuit is completely insulated; in Altona he found that a voltage of .04 to .07 was sufficient to interfere with the test, and that voltages as high as about .3 volt existed, also that it was worst during the hours when the lighting currents were greatest; in Hamburg only an insignificantly small voltage could be detected.

ELECTRO-CHEMISTRY.

Metals in Fused Salts.—"Ind. and Iron.," Sept. 15, reprints a short paper by Mr. Andrews, read before the Royal Society of Edinburgh, on the electro-chemical reaction of metals in fused salts; a table of some of the results is given.

Excelsior Primary Battery.—The Lond. "Elec. Rev.," Sept. 15, describes a battery by this name recently brought out in England; zinc, carbon and a porous cup are used; the depolarizer is made as follows: Bichromate of potash, 3 parts; nitrate of soda, 2; permanganate of potash, 2; broken carbon, 20; black oxide of manganese, 6; and chloro-chromic acid, 4 parts; these are mixed and fused together slightly, a current of oxygen being passed through the mass for an hour or so while hot; the depolarizer is regenerated by passing air through it with the mouth or a pair of bellows (but it is not stated for what length of time); the zinc is amalgamated by being immersed for an hour in a mixture of ½ oz. of nitrate of mercury, 1 oz. of hydrochloric acid and one pint of water; strong sulphuric acid is used in the porous cup, with a round cell measuring 4 inches in diameter and 6 inches in height, with an area of 17 inches per plate, a current of 2 amperes at 1.785 volts is obtained for 10 to 12 hours, after which the battery must be regenerated with air; it is guaranteed to run electric lamps at less than ½ cent per 10-c. p. lamp-hour. (It is a question whether the regeneration is as simple and as easy as one is led to believe.)

Dry Cells.—The "Jour. of the Inst. of Elec. Engineers," in its abstract mentions the "Germain" cell, in which the cellulose of the cocoanut is used; an oak box soaked in paraffine is made waterproof with a coating of rubber solution or tar; on the bottom is an amalgamated zinc plate which has a layer of cellulose soaked in hot hypochlorous acid and well pressed down; on this is placed the carbon surrounded by crystals of manganese dioxide, on which is a second layer of cellulose and a second zinc plate, the whole being pressed together by strong springs; the E. M. F. is 1.5 volts.

MISCELLANEOUS.

Electric Smelting and Casting.—"L'Elec.," Sept. 16, contains an illustrated description of the apparatus used in the Taussig method, described at some length in the Digest, April 8; the object is to produce castings without blowholes; the mold in which the metal has been cast is placed in a chamber from which the air is exhausted and a current of electricity is passed, by the aid of two electrodes, through the casting to keep it in a molten condition; in a second form of apparatus illustrated the chamber in which the metal is melted is directly above the one containing the mold, the air being exhausted from both; the metal is melted in the upper one by means of an electric current, and after flowing into the mold it is kept molten by means of a shunted current; the Martin-Siemens steel has thus been cast; tests made with castings are said to show a remarkable tensile and bending strength; with a current of 50 volts and 30,000 amperes, equal to about 2,000 h. p., about 3,000 pounds of metal can be melted in 15 minutes in a trough about 38 feet long and 32 square inches in cross-section.

Currents Between Gas and Water Pipes.—Referring to the experiment mentioned in the Digest, July 8, Dr. Kalischer, in the "Elek. Zeit.," Sept. 22, describes a long series of experiments covering a period of six months, and including 2,000 observations, made in order to determine whether this current has any connection with the earth's magnetism or with meteorological disturbances; his results show that no such relation appears to exist; the current is never constant, but varies greatly and suddenly; the maximum voltage was about .0024 times that of a Daniell cell; the minimum value .0004, while generally it is about .0018; considering it as a cell, its internal resistance varied between .59 and .03 ohm, the most frequent value being .4 ohm; the direction of the current is from the water pipes through the earth to the gas pipes, thus making the latter the positive pole to the external circuit.

Publication of Scientific Papers.—In a paper by Mr. Basset, read at the recent B. A. meeting and reprinted in abstract in the Lond. "Elec. Eng.," Sept. 22, he discusses the feasibility of a scheme for the publication of a digest of all papers read at scientific societies in Great Britain by the co-operation of these societies; the plan is similar to that of Law Reporting, and the authors are required to add a note to their papers briefly setting forth the object of the investigation; every few years these abstracts are to be classified and published; he adds that it might be advisable to arrange with the journal "Nature" to publish these digests for the societies in the form of a supplemental number about four times a year.

Mechanical Power.—The Lond. "Elec. Eng.," Sept. 15, reprints the first portion of the presidential address of Mr. Head before the Mechanical Science section of the British Association; it is quite interesting reading, but contains nothing pertaining to electricity; among other things he gives the powers of man and animals, aided and unaided, and of machines; the paragraphs on locomotion on land, on water and in air, contain quite interesting matter. The conclusion of the paper is contained in the issue of Sept. 22.

Electric Kite.—"Cosmos," Sept. 16, gives a well illustrated description of a kite made by a French electrical instrument maker for the purpose of collecting atmospheric electricity as in Franklin's famous experiment. This modernized kite is arranged so that it can be conveniently rolled up for transportation, resembling a closed umbrella; it is about 7 feet high; arrangements are shown for insulating the end of the string from the earth and for drawing out the charge, the whole forming a convenient physical apparatus; as in Franklin's experiment, the conductor is formed by a string which is moistened with acidulated or salt water; it is stated that with this apparatus sparks of several yards in length may be obtained.

Lightning.—"Cosmos," Sept. 9, records the case of a recent bolt of lightning in France, which struck some trees on a farm near a pond about 30 feet long and 12 feet deep containing over 1,000 fish; after the storm was over it was noticed that all the fish had been killed, presumably by the lightning.

St. Elmo Fires.—The "Elek. Zeit.," Sept. 22, publishes an abstract of a paper published in Austria, giving a number of deductions made from 670 observations of St. Elmo fires occurring on 35 different days during observations extending over about two years in a mountain observatory in Austria.

Prizes.—"La Lum. Elec.," Sept. 9, publishes a list of prizes offered by the Societe d'Encouragement for the next three years for a number of papers, apparatus, etc., some of which relate to electrical subjects. The list is also published in "L'Ind. Elec.," Aug. 25.

Mr. Martin's Lawsuit—Its Object Cash, Not Vindication—Fruitless Exertion—Why and How It Failed.—III.

We continue our report of the case of Martin vs. Johnston, taking up the cross examination of the plaintiff at the point where it was dropped at the close of the last report in last week's issue. During the sessions reported in this number the defendants introduced in evidence some more of Mr. Martin's characteristic letters, and brought out several facts which go to show even more clearly than anything already published, how complete was the absence of any excuse or justification for this lawsuit.

CROSS-EXAMINATION OF MR. MARTIN CONTINUED BY MR. KEIGHARN:

Q. Do you remember when Mr. Johnston came back from the Kansas City convention? A. I know he came back.

Q. Tell us when he came back? A. I do not remember.

Q. Do you remember that during his absence there you received some dispatches from him? A. No, sir.

Q. Is your memory such that you are willing to say you received none? A. My memory is such that I know everything went to Mr. Colvin, whatever came.

Q. Did you receive anything that came from Mr. Johnston through his hands? A. Not that week.

Q. Mr. Johnston sent on to you, as editor of the paper, a report of the convention. A. No, sir.

Q. Who did he send it to? A. I don't know.

Q. Did any such report reach you during Mr. Johnston's absence? A. No, sir.

Q. You are positive also about that? A. I am positive about that? The stenographic report did reach me ultimately on Monday morning, if I recollect aright.

Q. Did you receive any of it during the week of the convention? A. I do not recollect receiving any.

Q. When Mr. Johnston came back from the convention, which I understand was Monday morning, did any trouble arise between you and him as to the report of the convention which he claimed was sent to you? A. Well, I got none; I don't know what he claimed.

Q. Did any trouble arise between you? A. I got some of the report on Monday morning.

Q. Did any trouble arise between you and Mr. Johnston as to the report which he claimed to have sent? A. I got some of the report on Monday morning, and began to work on it, and worked very hard, and about midday he took it away from me.

It was necessary to ask this question about the report three times before he answered it. He dodged it twice. All this and what immediately follows appear to have been a little evasive.

Q. What did he say to you when he took it away? He just demanded it.

Q. Did he find any fault with you for not editing or preparing it? A. He just demanded it and I gave it up.

Q. Did he give any reason? A. I do not recollect that he did; he wanted it.

Q. The issue of the paper it was published in was late, was it not? A. Very late.

Q. Did Mr. Johnston make any claim on Monday morning that the delay was caused by your neglect in not having it ready? A. Not to me.

Q. Do you recall making any complaint that the report which Mr. Johnston sent on was in very bad form? A. I did not take exception to the report.

Q. Do you remember saying to Mr. Johnston that he had bungled the matter, and you knew he would bungle it? A. I do not remember that.

Q. When he took the report out of your hands, what did you say to him? A. I objected very strenuously.

Q. In what form? A. To having it taken away from me.

Q. On what grounds? A. As editor of the paper.

Q. Did he make any reply? A. He took it.

Q. Did he make any reply? A. I do not remember a reply. He took it.

Q. Was Mr. Wetzler present when he took it? A. I believe he was.

It will be perceived what a peculiar situation this was.

Mr. Martin swears positively that he received nothing pertaining to the convention—neither reports nor any communication—from Mr. Johnston while he was at Kansas City. When pressed he says what he received came from Mr. Colvin, but not during that week.

One peculiarity of this is that, as to our ascertaining what the facts were, we might as well have endeavored to get them from a man that was dead as to find out from Mr. Colvin. It will be remembered when he was a witness on behalf of Mr. Martin his recollection was such as not to enable him to recall some important incidents. As he put it himself, when answering one question, "I do not recollect anything on that day any more than any other day."

There is also another peculiarity about this.

The report referred to was forwarded from Kansas City each day, as it was ready, and reached the office of The Electrical World, or at least ought to have reached it, on different days between the 14th and the 17th of February. As shown by the testimony, some of it was mailed on the 12th, and the mail time between Kansas City and New York is 48 hours.

Early on the morning of the 10th, at about 9:30 a. m. (time attested by "Jos. Wetzler, witness"), Mr. Martin, "editor," "vice-president of The W. J. Johnston Company, Limited"—second in command—"vested with all powers in the absence of the president," took supreme control of The Electrical World's affairs in New York, and extinguished the faithful Mr. Colvin and all his authority.

In doing this, Mr. Martin informed Mr. Colvin in writing as follows:

"In the course of a seven years connection with the paper I have never yet failed in any duty to it, and I certainly should not do so now."

Just why Mr. Martin was at the pains to give Mr. Colvin this valuable piece of information we never could understand, unless he was afraid that Mr. Colvin might be under some misapprehension on that subject.

All that Mr. Colvin had heard, and the appearance of the paper sent out to the world on the Saturday evening before with no editorials and some other blemishes, Mr. Martin may have been afraid had created in Mr. Colvin's mind some such wrong impression as that during his seven years connection with The Electrical World he had been guilty of at least one slight lapse—but this is neither here nor there.

Mr. Martin, however, on this Feb. 10, at 9:30 was in control, and remained so during the whole week.

He was then completely free from all Mr. Johnston's interference and annoyance, including "vindictive torture," and Mr. Colvin and every one else was relegated to the background and completely out of sight.

Why did not Mr. Martin then, according to his habits of fidelity cultivated by "a seven years" connection with the paper, find out why the report did not come to his hands during the week?

Mr. Colvin would not have dared to withhold it from "the vice-president of the W. J. Johnston Company, Limited—vested with all powers in the absence of the president," and who had just enjoined upon Mr. Colvin to submit to him everything in or about the office, "including the disposal of all correspondence."

It is certainly remarkable that when Mr. Martin went on the witness stand he had not at least some excuse to offer beyond such expressions as: "Everything went to Mr. Colvin, whatever came"; "it reached me ultimately; I got it on the Monday morning following the convention."

If he had only told us of his struggles during the week—his efforts to prolong his term of fidelity beyond the "a seven years" limit—and to discipline Mr. Colvin and make him surrender the report—or if he had produced Mr. Colvin and he would swear that the report did not even reach him, and therefore the fault lay entirely with the United States mail, and neither with him nor with Mr. Martin—this would have been fairly satisfactory. But no; what Mr. Martin offered was his only excuse; and thus this important matter rested beween himself and Mr. Colvin. The defendants offered to recall Mr. Colvin and cross-examine him on this and some other points, but Mr. Martin declined the invitation, and while he objected the court decided that it had no power to grant the request.

This whole explanation of Mr. Martin's is very peculiar.

The witness identified a letter written by him to Mr. Johnston, date of Feb. 17, 1890, which we give in fac simile, on next page.

Q. Mr. Martin, will you kindly inform me what was the occasion for writing that letter to Mr. Johnston under date of Feb. 17, 1890. A. That was when Mr. Johnston took that stuff away from us. As this letter sets forth, Mr. Colvin handed me this matter of the report on Monday morning, and we set to work and just dug at it as hard as we could go, and put in every possible minute at it. We worked very hard, indeed, and Mr. Johnston came into our office about an hour or two after that, and jumped on us, and took it away, and I objected to being balled up in that manner. Mr. Johnston rushed into my office and demanded that I should give up the stenographic report. I did so, saying I could not get along with it, if he did that.

Q. When Mr. Johnston went in there, and made the demand for the report, as a matter of fact where was the report? A. In my desk.

Q. It was locked up, was it not? A. I think it was.

Q. You were not working on it then? A. I had my hat on, going out for lunch.

Q. How long had you before that ceased working on it? A. About one minute.

Q. And you locked it up? A. Yes.

Q. What was the object of locking it up? A. I lock my desk as a general thing going out for dinner.

Q. Was it usual for Mr. Wetzler to remain in the office when you went to lunch, or did you go together? A. As a general thing we went together.

Q. After you came back from lunch how long afterwards was it that you wrote this letter? A. I cannot say.

Q. You have no idea? A. I cannot say.

Q. When Mr. Johnston made the demand on you for the report, spoke to you about editing it, did he say to you that the printers were clamoring for manuscript? A. He did not.

Q. Are you sure of that? A. I will swear to it.

Q. Perhaps he did not say "clamoring"? A. It would not be true anyhow; I had offered the printers plenty that morning.

Q. There was quite a large quantity of the report which I have been referring to? A. A big stack of it.

This letter, which is published in fac simile on page 296, is equal to anything that was ever penned as a sample of pure "cheek," coming as it did from Mr. Martin, a man who cut up the capers he did with the paper, a week before, on February 8.

He says in his testimony he was going out to lunch, and that he had locked up the report. It never occurred to him that he was thereby preventing any one from touching it while the printers were waiting to set it up in type.

He would not or could tell how long after Mr. Johnston took the report he wrote this letter—how long he took to mature this operation. His talk about "hinderance" and "interference" was only another step in the plan he was forming.

Q. What was the occasion for writing that thing which you refer to as the protest? A. Mr. Johnston dismissed Mr. Wetzler for alleged misdemeanors in December, and I filed this protest in the directors' meeting.

Q. You took sides in the quarrel with Mr. Wetzler, in opposition to Mr. Johnston? A. No, sir, I took no sides. I did what I believed to be right.

Q. Right or wrong, you were on Mr. Wetzler's side? A. I did what I believed to be right.

The "Protest" will be found in fac simile on page 297.

Q. The paper upon which you are employed now is in the same line of business as the World? A. Yes, sir, it is a paper of the same character.

Q. The witness who was examined here, Mr. Colvin, is also employed on that paper? A. Yes.

Q. After you left the employ of the World and went to the "Engineer," did you make any efforts to get the other employees or some of them to leave the World and go to the "Engineer"? A. I did.

Q. You were trying to take away the employees that Mr. Johnston had in his office? A. I did not try very hard.

Q. You made efforts? A. Yes.

RE-EXAMINED BY MR. MASTEN:

Q. You say you did make efforts to get other employees to leave The Electrical World—explain a little more fully what you mean by that? A. A lot of them came to me and wanted to work for me.

Q. Did you of your own motion approach unsolicited any of Mr. Johnston's employees, and endeavor to get them away from his paper, and if so, whom and how many of them? I do not think your former answer is explicit enough. A. I did in one case of a man who was having some trouble with the office.

Q. With Mr. Johnston's office? A. Yes.

Q. Who? A. Mr. Shaw.

Q. And the others came to you and proposed of their own accord to go with you? A. A great many of them.

Q. With regard to this issue of Feb. 15, 1890, will you state generally what are the principal points of difference between that part of the issue that went to press on Saturday and that part of the issue which was printed in the following week? A. The differences consisted wholly of matter which came in on Saturday.

Q. In the first place, there was no editorial matter in the original edition? A. There was no editorial matter in the baseball edition.

Q. The original edition? A. That is what we call it.

Q. Look at this paper which I now show you bearing date February 15th, and state if that was the original part of the issue which went to press on Saturday? A. I believe so. I got a copy of it from the files in The Electrical World office.

Q. That is what you have alluded to as the baseball edition? A. Yes.

Q. Look at this and state whether or not this is the paper of the following Monday morning? A. That is the paper I got out on the following Monday.

Mr. Masten: I offer both papers in evidence. With the exception of the differences on the editorial page, what other differences were there between those two papers, as far as concerned the reading matter? A. The differences outside of the editorial matter consisted almost wholly of out-of-town matter which arrived on Saturday, correspondence and this article (pointing to an article), miscellaneous illustrated articles, and one or two articles of my own that morning, and one which Mr. Wetzler wrote the previous night and were printed in the morning.

Mr. Keigharn: Will you have him point out what he claims arrived on Saturday morning?

Mr. Masten: Will you point out the pages, go through it page by page, and show the differences so far as concern the two editions?

Witness: I believe there is a difference on page 108; on page 108 is an article, "A Farewell Dinner to Mr. O. E. Madden," and that matter I got over the telephone on Saturday morning and wrote it myself. It was turned in that morning. There is also a letter by Mr. A. L. Ide, entitled "Electrical Engine Governing," which, to the best of my belief, came in that morning; that is on page 108. The next page is all right; the next is all right; the next all right; the next all right. This cut on page 115 reached me about four or half-past four on Saturday afternoon.

Mr. Keigharn: The engraving you mean? Witness: Yes. Yes, that is on page 115. I tried hard to get that earlier in the day, but did not succeed. Page 116, all that is Saturday matter, if I mistake not. "Universal Tin Shade" and "Testing Interior Electrical Conduits," Wetzler wrote that on Friday night and gave it in on Saturday morning. On page 117 is an article on "Triumph Compound Engine." I believe that came in on Saturday morning. I believe it differs from the other papers; yes, it is a Western article; it came from Cincinnati. Then we get over pages 117 and 118. On page 119 New York notes came in on Saturday morning. It came from Mr. Hunt; I wrote that from his notes myself on Saturday morning. These New England Notes—a great many came in on Saturday morning, on pages 119 and 120. Philadelphia Notes, the second page, came in either Friday or Saturday morning. Western Notes were largely received on Saturday morning, probably two-thirds or three-quarters of them. English Notes, I think, had been turned in; that second batch may have come in late; they usually arrive on Saturday. Then there are some miscellaneous items which I have a very distinct recollection of having turned in on Saturday morning.

Mr. Masten: I understand you to say that there was one of these articles which was accompanied by a cut on page 115, but did not reach you until late Saturday afternoon? A. Yes, sir.

Q. By whom were you furnished with that cut? A. It came from the engravers on my urgent request to Mr. Stump to get it for me.

If this and the question which follows meant anything, it meant to make it appear that the absence of this cut delayed the make-up of the paper. Two witnesses, however—one Mr. Stump himself, the other Mr. Welthas, who had charge of the mechanical part of the make-up of the paper—testified, as will appear, that the absence of this cut would not at most delay the paper more than one hour, as Stump said, merely to lock up the form.

Q. Was it possible for that page of the paper and the typographical matter to be placed and arranged without the cut? A. No, sir, but I did make up the page without the cut, and inserted it afterward. I got the measurements from Mr. Stump.

Q. I understood you to state that it was the custom of the office to prepare editorials as the last work before going to press? A. Yes, sir, always the last work.

Q. That was the usual and regular custom? A. I might say invariable.

Q. What was the reason of that? A. Because it was generally a waste of time to write editorials until we knew what was in the paper.

Q. Did the contents of the paper depend or not, to a large degree, upon the mail matter that came in to the paper? A. Very largely.

Q. And was that used and relied upon for the purpose of writing editorials by the editorial staff? A. Some of it; it depended on what its nature was.

Q. You looked to that for suggestions? A. We looked to everything; we used the editorial page as a finger post to the contents of the paper, so as to make people read what was inside.

Q. Do you recollect at what time the mail matter was delivered to you at the printing office from the office of The Electrical World on this Saturday? A. Just about lunch time.

The Referee: When was that? A. About half-past 12.

Mr. Masten (to Witness): Did you go out to lunch on that day? A. No, I stopped in for the purpose of doing that.

Q. Before the matter arrived on that day had you made efforts to obtain it more speedily from the office of The Electrical World? A. I tumbled over myself trying to get it.

Q. What had you done for the purpose of expediting it? A. I had gone to the telephone a great many times, but paid a visit to the office about 9:15 or 9:30 to get it.

Q. Was it feasible for you to fully complete your editorial matter until you had the last installment of the mail matter received on the day when the paper went to press? A. It was quite impossible for me to complete my editorial work on that account.

To any one at all interested in the somewhat extraordinary story which this case discloses, it will be worth while to bear this explicit and emphatic answer in mind, and contrast it with what he says very shortly after.

In reply to some remarks of Mr. Johnston, you informed him that you did not propose to stay after hours, it was five o'clock and you were going home. As a matter of fact, was it your practice, as a rule, to work in the evening as well as in the daytime—work on the paper? A. Yes, sir, I did work every night that week.

Q. You worked at your house, do you mean? A. Yes.

Q. At that time what was the condition of your health? A. I was in a state of weariness and mental anxiety all that week; my wife lay very dangerously ill, very.

Q. Were you occupied from the time you came to business until the time that you left, except in the business of The Electrical World and your duties as editor? A. None whatever; I was not any part of that time idle.

Q. As to the subsequent part of the paper, which was printed on Monday, what about your duties in regard to it? A. I got down about 8:15 on Monday, and they informed me at the printing office that Mr. Johnston had issued a paper on Saturday night, and I did not know what to do. Presently Mr. Colvin came along with this letter, and I told him—

Mr. Keigharn: I object to what was told Colvin.

Mr. Masten (to witness): State the circumstances under which you went to work on the second part of the edition on Monday morning? A. I either got a copy of the paper or the proof pages, and was very much dissatisfied with the look of things, and made up my mind that that would not run. Then Mr. Colvin came down and I told him I was going to make up another paper.

Q. What time did you get the paper to press on that Monday? A. By midday; very swiftly.

Q. What time did you get it out from the press? A. Early that afternoon.

Q. When was it sent to Kansas City? A. Early in the afternoon of Monday, by my orders.

In all of these statements, viz., that the paper was sent to the press-room about midday, and was got out early in the afternoon, and copies forwarded to Kansas City early in the afternoon of Monday, the witness was contradicted by at least three witnesses—Newman, Weithas and Smith— and, in fact, also by Wetzler; all of these proved that the paper did not leave the printing office until late Monday evening, did not leave the press-room until Tuesday forenoon, and was sent to Kansas City sometime on Tuesday evening or night.

Q. It would have been possible, would it not, to have printed the edition of the paper complete on Saturday, if you had stayed long enough? A. Yes, sir; I was hoping to get through by six o'clock.

Q. Did you apply to Mr. Johnston, when he came there and proceeded to interfere with you, for instructions as to what you were to do to get the paper out? A. Yes, sir; I did. I asked him to let me finish my work.

Q. Did he reply? A. No.

Q. He said nothing to you while he was there? A. No.

Q. Did he have the appearance of being in sulky temper? A. Yes.

Q. Is there any foundation whatever, Mr. Martin, for the statement or the claim that it was your desire to go to this Kansas City Convention, to the exclusion of Mr. Johnston? A. No, sir; it is utter nonsense.

Q. Did you want to go? A. I wanted to stay at home. My wife was very seriously ill. I did, however, very emphatically advocate that some representative of the editorial staff should be present at the convention.

Q. And in sending that telegram, which was read this morning, in which you speak of being debarred from attending the convention, that was simply an expression of ordinary regret?

Mr. Keigharn: I object to that.

The Referee: Objection sustained.

Q. Were you influenced at all in any way in your action with regard to this convention issue, or any of your proceedings toward Mr. Johnston by the fact that he had gone to the electrical convention and you hadn't?

Mr. Keigharn: I object.

The Referee: Objection sustained.

Mr. Masten (to witness): With regard to this convention issue, were you desirous of having the paper appear in time for distribution at the convention?

Mr. Keigharn: I object.

Referee: Objection sustained.

Q. Whose suggestion was it that this paper should be printed ahead of time for the purpose of having it at the convention? A. Mine.

Q. With regard to the question of examination of the books of the company, prior to this occasion when you went in to examine the check book, had you made any request of Mr. Johnston for a statement of the financial affairs of the company? A. Yes, sir; several times.

Q. Had he promised to make any such statement? A. Yes, sir.

Q. Had he kept his promise? A. No, sir.

Q. Was a request made of him at this annual meeting of which you spoke for such a statement? A. I made a request that day.

Q. What statement did Mr. Johnston make with regard to the financial affairs of the company, in response to your request, if any? A. He said the only statement he would make was that the affairs of the company were in a very flourishing condition.

Q. Prior to the time when you went into the office to examine the check book, had there been any negotiations between you and Mr. Johnston looking to your resignation, and the purchase by him of your stock? A. Yes. Through Mr. Hull.

Q. You stated, the other day, that on the morning of Saturday, the 8th of February, you went to the office of The Electrical World from the printing office? For what purpose did you go? A. To see if I could facilitate in getting the mail matter from the office.

THE ELECTRICAL WORLD
the Pioneer Weekly Electrical Journal of America
Issued every Saturday by
THE W. J. JOHNSTON COMPANY, LIMITED
W. J. JOHNSTON, Pres. CLARENCE E. STUMP
T. COMMERFORD MARTIN & JOSEPH WETZLER, M.E.'s

New York Feb 17 1890

W. J. Johnston Esq
President The W. J. Co Ltd

Sir

We advise you hereby that your interference with us in the faithful discharge of our duties, as Editors of this paper, renders it extremely difficult, if not quite impossible, for us to do our work properly and satisfactorily to ourselves or the readers of the paper.

To be specific in one complaint, for example. We received this morning at 9.45 am. from Mr Colvin 85 typewritten pages of Thursday Kansas City report and 112 pages of Friday K C report. The matter was at once given attention, and no fewer than 80 pages were carefully edited and sent to the printers by 12.30, in spite of numerous interruptions from calls and necessary attention to other editorial cares. At 12.45 pm. you took all the remaining matter out of our hands, saying you would assume the responsibility.

Under these circumstances, the delay and bad work with the matter we have not seen must rest with you, for no one can do his duty when thus hindered and obstructed.

We propose to bring this matter before the next meeting of the Board of Directors.

Yours &c
T. C. Martin
Jos Wetzler.

Editors, The Electrical World

MESSRS. MARTIN AND WETZLER'S MATURE ADVICE—DON'T INTERFERE WITH THE "FAITHFUL."

Q. Whom did you see there with reference to that subject? A. Mr. Colvin and Mr. Stump.
Q. What did Mr. Colvin say?
Mr. Keigharn: I object to that.
The Referee: How is that competent?
Mr. Masten: Simply from the fact, as it already appears here, that Mr. Martin was endeavoring to get this mail matter over there, and Mr. Colvin says he remembers telephoning for it, and I want to show that Mr. Colvin declined to give the mail matter, on the ground that he could not deliver it till Mr. Johnston came and had gone over it. The delay in this matter was Mr. Johnston's fault.
Objection sustained.

It would have been the easiest thing imaginable for Mr. Martin to have produced Mr. Colvin, if he really thought it was desirable to prove the fact sought to be established by this question, and he believed that Mr. Colvin could have proved it. The only objection there could have been to this course was that it might have turned out that Mr. Colvin could not have proved the fact after he had been cross-examined. Colvin knew a good deal more about this whole matter than what Mr. Martin's questions called out, and it may have been prudent not to have exposed him to cross-examination. That sort of a mistake appears to have been made by calling Mr. Knight and Mr. Stump.

Q. Was it common in the printing of The Electrical World to have the printers stay over time, and keep the press-room open?
Objected to. Objection sustained.
Q. Will you state, Mr. Martin, the causes of the delay in getting the paper into press on Saturday, the 8th of February? A. The delay was due to the fact that I could not get the matter, which should have reached me the first thing on Saturday, until very late in the day, in spite of my repeated efforts. I made application to Mr. Colvin and Mr. Stump to help me to get that matter, and after some little delay (about half past nine, the time was) I thought I had better go over to the office and see if I could not get it by personal application for it. I failed to get the matter. I was buffeted about, and went to Mr. Stump, and failed there.
Q. What time did this mail matter finally reach you? A. It was just before lunch, about half past 12.
Q. Now what other reasons were there besides the fact that the mail matter was late in reaching you, for the delay of this paper on February 8th? A. The fact that, owing to the late delivery of that mail, I was unable to make out, or carry out, any clear or consecutive plan of making up the paper, there was so much of it that came in at that time.
Q. Was there any further reason? A. I can't recall them; that was the thing that did it.

"That was the thing that did it," says Mr. Martin. His counsel seemed to think, however, that something else played a part in the operation, though Mr. Martin could not recall it. Perhaps the lawyer thought it was not prudent to rest entirely on this excuse—that the mail had been withheld or delayed. His questions certainly go to show that he wished to back that up by showing something else—that nobody had asked the printers to remain and work overtime—so he went at Mr. Martin again on this point.

Q. Were you informed in the afternoon of that day by Mr. Johnston, or anybody claiming to represent him, that it would be necessary to have the printers work overtime? A. No, sir.

If there was ever anything superbly ridiculous it is the claim tried to be put forth on behalf of Mr. Martin in this question.

What would make the necessity for the printers working overtime but the backward state of progress on the paper? Who was to know of this, and who was, or could be, responsible for making this state of affairs known but Mr Martin himself, and he alone? He was the editor, and as he swore he was responsible.

The shallowness and absurdity of this will appear even more clearly later on, when it is seen that he never made any request that the printers should work overtime, and never disclosed to any one the necessity for having them do so.

Q. Were any instructions given from the main office to the printing office, to your knowledge, by Mr. Johnston, or anybody else, on that day to have the printers in the press-room remain in readiness overtime? A. None, whatever, to my knowledge.
Q. What was the regular hour for closing the printing office on Saturdays? A. Five o'clock.
Q. Was it possible for you to get the paper to press on Saturday afternoon, in view of the circumstances you have stated, unless the printers did work overtime after five o'clock? A. Had the printers worked overtime, the paper would have been through by six.
Q. The question is, was it possible to get it out unless they did stay overtime? A. No, sir.

Even admitting all Mr. Martin here claims, this did not alter the fact that Mr. Martin did not have the paper ready at the time he abandoned his work on it.

Q. Had there been on this day any orders given, to your knowledge, by Mr. Johnston, or anybody else claiming to represent him, that the paper should go to press at noon, or any fixed hour? A. None, whatever.
Q. As I understand you, some of the articles that were published in the two editions of Feb. 15 came in from out-of-town contributors? A. Yes.
Q. And was the same true of the out-of-town notes by the correspondents? A. Yes.
Q. Did that matter which was intended for this issue of Feb. 15 reach The Electrical World editorial staff any earlier than usual because the paper was going to press earlier? A. To my knowledge—no, sir.
Q. State what passed between you and Mr. Johnston, with regard to Mr. Wetzler's affairs immediately prior to the writing of this letter of Dec. 4, 1889 (the protest). A. Upon his return from Europe, I had a conversation with Mr. Johnston with regard to Mr. Wetzler and his conduct while he was in Europe. Mr. Johnston thought he would get rid of Mr. Wetzler, and discussed the matter with me, urging certain reasons. I urged certain reasons to the contrary. It was done quietly and pleasantly. At last, on Nov. 30, in the afternoon being Saturday, Mr. Johnston sent for me and told me that, upon the whole, he agreed with me; it was decidedly for the best that Mr. Wetzler should be retained in the office as associate editor with myself, and that he had written him a nice letter to that effect. The Wednesday morning following that, I saw Mr. Johnston and told him that I had seen the letter, and that I found it to be a flat-footed dismissal; whereupon I filed that protest.

RE-CROSS-EXAMINATION BY MR. KEIGHARN.

Q. Now, Mr. Martin, you said this morning that the mail matter which you were looking for on Feb. 8 caused the delay in the issue of the 15th? A. Yes.
Q. Won't you be kind enough to tell me what you got out of that mail when it finally reached your hands that was used in making up the paper? A. Quite considerable matter.
Q. Specify all of it, if you can; if not, specify as much as you can? A. To the best of my belief, the bulk of the Western Notes, quite a portion of the New England Notes, some of the Philadelphia Notes, some of the articles and some of the cuts.
Q. Now, do you want to specify what the articles were, and what the cuts were? A. "The Central Lightning Arrester," "The Tin Shade," "Harmont District Telegraph Box." There is a doubt in my mind as to the article on the "New Triumph Compound Engine," but the cuts I believe I got that morning; the article, "Testing the Interior Electrical Conduits" and the letter from Mr. Ide, on page 108 I think came in that morning.
Q. How many articles have you referred to now? A. Five, The article, "Testing the Interior Electrical Conduits," and the New England Notes—some of them—came in that morning, to the best of my belief.
Q. Can you specify which? A. I can't do that.
Q. Do you claim that all the New England Notes arrived on Saturday morning? A. No, sir. I should say about two-thirds of them.
Q. How about the Philadelphia Notes? A. I think that last batch came in that morning; and there are two batches of English Notes. That last page, I think, came in that Saturday morning, and some of these notes—not a great many, but still, some.
Q. Now, assuming that those papers which you refer to had not arrived until the time you speak of, was it necessary for you to delay the issue of the paper until they reached you? A. Why, yes, that was just the reason we were hurrying the paper. Some of these articles came from our most important advertisers and they had to go in.
Q. Will you specify what had to go in? A. "The Central Lightning Arrester," "The Universal Tin Shade," "The Harmont District Telegraph Box," the letter of Mr. Ide, a lot of these New England Notes referring to the business of our advertisers, some in Philadelphia, and some in the Western Notes.
Q. Did the absence of those in your hands on Saturday morning—as I understand, at 12 o'clock—prevent you from issuing the paper on Saturday afternoon? A. The delay was due to that.
Q. Now, is it not a fact (looking at the paper which

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W. J. Johnston, Pres. Clarence E. Stump, Treas. & Sec. Manag.
T. Commerford Martin & Joseph Wetzler, Editors

New York Dec 4th 1889

Having learned, with great surprise, from Mr Joseph Wetzler, who is associated with me as Editor on The Electrical World, that he has received from Mr W. J Johnston, president of the W. J Johnston Company Limited, notice of termination of his contract, I feel it to be my duty as a Director and Stockholder of the Company, as well as the Editor of the paper, to express in this formal manner my deep regret at this action on the part of the President, as being one which, however well intentioned, is in my firm opinion, calculated to do injury to the business of the Company as a Whole, and to be prejudical to The Electrical World among electrical people. I consider that the paper as it stands to-day is largely the product of Mr Wetzlers intelligent, faithful and sustained labors through a period of five years His dismissal would not only be liked to excite adverse and hurtful criticism outside the office, but would certainly impair the efficiency and dampen the ardor of those who remain on the staff. For these reasons I am impelled by what I believe to be right to place on record my respectful protest against such action

T. C. Martin

original.
Jos Wetzler Esq.

MR. MARTIN'S PROTEST: AN ADROIT EFFORT ON BEHALF OF A FRIEND.

was issued on Saturday after you left the office) that the article "The Central Lightning Arrester" was published in that paper. A. I tried to say it was; quite likely; of course it is a fact; no question about that.

Q. Is it also a fact in reference to the article you call "The New Universal Tin Shade"? A. Why, of course, the papers show it.

Q. Now, is Mr. Ide's letter also published in the first edition of the paper? A. Why, yes, it looks like it.

Q. As a matter of fact, that paper was issued on Saturday, wasn't it? A. I don't think there is any question about it; I have no question.

Q. I understoodd you to say, or rather to claim, that because the printers refused to work overtime on Saturday, Feb. 8, was the reason why the paper was not issued? A. I never said any such thing.

Q. What did you claim this morning in answer to Mr. Masten's questions? A. Nothing of the kind.

Mr. Martin evidently had not much faith in the efficacy, as an excuse, of trying to show that the printers had not been ordered to work overtime.

Q. Did you make any allusion at all to the printers? Do you remember what you swore to about an hour ago? A. I think I do.

Q. Didn't you say it would be impossible to issue any paper on the evening of Saturday the 8th, unless the printers worked? A. I think that was the truth.

Q. Is it a fact that on prior occasions you had the printers work after five o'clock for the purpose of issuing the paper? A. Yes.

Q. How often has it happened? A. Not a great many times; frequently. We tried to avoid it as much as possible. It may be, at a rough guess, a dozen times a year; I think that would be near it.

Q. When it happened on prior occasions, did it always happen at Mr. Johnston's orders? A. Mr. Stump's orders.

Q. Was there ever an occasion when you ordered it? A. Not at my own ordering, no, sir.

Q. I understood you to say on your examination, the last day here, that you knew it was necessary to have the paper issued on Feb. 8; am I correct in that? A. Yes.

Q. You knew, also, that it was the purpose of Mr. Johnston to have it issued? A. It was my purpose.

Q. It was also Mr. Johnston's purpose? A. I presume so, but I have no proof of it.

Careful and cautious man, this Mr. Martin, not to state under oath any fact of which he did not know the existence by positive proof.

Q. As you said a few minutes ago, it was necessary to have it to comply with your advertisers' requests? A. Yes, and personal friends of mine, too.

Q. What was your object this morning in saying, as you did on your examination, that you tried to get orders from Mr. Johnston, whether it should be issued or not? A. In order to complete the issue that evening it was necessary that those men should work after five, and I arranged to get orders to that effect.

Q. Had you, yourself, sought to have them work before you left the office? A. Yes; Mr. Newman had been talking about it and discussing the advisability of it.

Q. And you say that you applied to Mr. Newman and asked him to let the men stay after five, for the purpose of putting the paper to press? A. I don't say that I applied to him.

Q. If you will just say what you asked Mr. Newman? A. I say Mr. Newman was discussing the advisability of having the men stay to get the paper out.

Q. I ask you whether or not you made a request or demand upon Mr. Newman, or any one there in the printer's office, to have the men remain there after five o'clock? A. I made no demand; no, sir.

Q. Did you make any efforts of any kind to have them remain? A. I did.

Q. What were they? A. After talking it over with Mr. Newman, I went to the telephone and called Mr. Johnston's office—somewhere in the neighborhood of half past four—and asked for Mr. Stump and Mr. Johnston; my communicant was Mr. Colvin.

Always Mr. Colvin; the safe and reliable Mr. Colvin. But Mr. Martin did not bestir himself to get the printers to work overtime until half past four; and he abandoned the printers, paper and everything else at five. He ought to have explained what he wanted the printers to remain for.

Q. After that, how soon did you see Mr. Johnston? A. A very few minutes after that—20 minutes, or so.

Q. What hour was that? A. Close on five o'clock.

Q. You saw Mr. Johnston then at the printer's office? A. Yes.

Q. What did you say to Mr. Johnston then? A. I asked him for instructions, and if he would let me alone and let me finish my work.

Q. What did you say to him about having the printers remain? A. *I don't recollect saying anything at all.*

Q. You didn't tell Mr. Johnston that you had already asked Mr. Newman to have the printers remain? A. I don't recollect saying so.

Q. Did Mr. Newman refuse to have them remain? A. *He did not refuse.*

Q. What did he say? A. I have a dim recollection of Mr. Newman saying to me that the men did not care to work on Saturday nights.

Q. And when he said that, what did you say? A. I called up the office.

Q. After Mr. Newman said to you that the men did not care to work, did you persist at all in your efforts to have them work? A. Why, yes, we were working when Mr. Johnston came. I was at the stone myself, giving instructions to two or three of the men—standing up over the stone myself.

Q. When Mr. Johnston came in there did you tell Mr. Johnston that you had asked Mr. Newman to remain, and that he seemed to be indifferent about it, *or whatever the expression was that you used?* A. *I don't recollect anything of the kind; Mr. Newman was as faithful as I was.*

Q. Did you tell Mr. Johnston anything at all about the efforts you had been making to have the printers remain there and work? A. *I haven't the slightsst recollection of telling Mr. Johnston auything of the kind.*

Q. Why didn't you? A. *You might as well try to talk to a wild cat.*

Q. Was Mr. Johnston very angry when he got there?

Objected to on the ground that the question has been asked before. Objection overruled.

A. It seemed like anger.

Mr. Martin was contradicted by every witness as to this statement about Mr. Johnston being wild or angry. Had he been both, however, it would not have been at all surprising, under the circumstances.

Q. Had you any idea as to what was the reason for his anger? A. No; he had been angry with me for about a month previous, and I took it all as a matter of course.

Q. What did you base your opinion on that he was angry, or that he was "a wild cat," as you expressed it? A. I beg Mr. Johnston's pardon for it.

Q. It's on the record. A. I'll let it stand as I said it.

Q. What did you base your opinion on that he was angry? A. From the manner in which he flew around the office.

Q. Was he doing anything? A. He went around the place and looked at things, and went up to Mr. Newman.

Q. Was he saying anything? A. I am trying to tell you.

Q. You haven't answered yet.

The Referee: Was he saying anything? Will you please observe me for a moment, and answer that question. A. Mr. Johnston was saying something to Mr. Newman.

Q. Did you hear what he was saying? A. I did not. I thought I caught something like instructions, but I don't know what he said.

Q. The only way that you know that he was speaking to Mr. Newman was by the action of his mouth and lips? A. I saw him speaking.

Q. What do you base your opinion on that he was angry? A. His whole attitude; his treatment of me and his treatment of Mr. Wetzler.

Q. What was the treatment, if he didn't say anything to either of you? A. When he won't answer it seems to me you have a pretty good idea of how he regards things. I asked for instructions, and he gave me no reply.

Q. What did you ask him? A. *I asked him if he would remain there until five o'clock.*

It came out at last.

So Mr. Martin did intend to quit his post at five o'clock, or, perhaps, before. When Mr. Wetzler was afterward asked if it had not been arranged between him and Mr. Martin, before Mr. Johnston came to the printers, to leave at five o'clock, he answered: "I think not." He would not say positively it was not, only: "I think not." He also said he did not remember whether he knew at the time when Mr. Johnston came to the printer's office that Martin wanted instructions; and further, he could not recall whether when he left the printing office on Feb. 8, he did not go at Mr. Martin's request.

Q. *Did you ask him if you were to remain there until after five o'clock?* A. *I don't remember asking that.*

Q. You say he ran around there pretty actively? A. Yes.

Q. What was he doing when he was running around? A. Looking at things.

Q. He was going around inspecting as to how far the work had been completed? A. Yes. He also went to the hooks and snatched proofs off of them; then he went to my desk and sat down there.

Q. When he went to your desk and sat down there were you at it? A. I was at the stone all the time working.

Q. This was a few minutes before five? A. It was around five.

Q. And you went away from there at five o'clock promptly? A. No, sir.

Q. How long after? A. ten or fifteen minutes.

Q. You only applied once to Mr. Johnston, while he was there for instructions? A. Three times.

Q. Do I understand you to say that you can't recall anything as to what your application was, except whether you were to remain till five o'clock? A. I can tell you exactly what I said to him those three times.

Q. If you will? A. When I saw Mr. Johnston speaking to Mr. Newman, I went up and asked him what instructions he was giving Mr. Newman.

Q. What did Mr. Johnston reply? A. Nothing. Then I went up to Mr. Johnston and asked him if he would give me instructions. Finally I asked Mr. Johnston if he would let me alone, and let me finish my work.

Q. What was the meaning of your asking him to let you alone, if he was not interfering with you? A. He was going around giving orders, taking my proofs and my desk, and no man could do his work under those conditions.

Q. Didn't I understand you to say a few minutes ago that you didn't hear what he said? A. Yes.

Q. How do you know he was giving orders? A. Because he went on after that.

Q. After what? A. After speaking to Mr. Newman he went on with the other men.

Q. You assume that because Mr. Johnston was talking to the other men in the office that he was giving orders? A. I did not assume that.

Q. Well, you didn't hear? A. I didn't hear it, no.

Q. You said the other day, Mr. Martin, when I was cross examining you, that you believed you delivered the editorials which you wrote on the 8th of February to Mr. Newman? A. Yes.

Q. Are you still of the opinion that you handed them to Mr. Newman before you went away from the office on the 8th of February? A. I am under the impression that I handed some of the editorials to him in that conversation I spoke about.

Mr. Newman contradicted Mr. Martin in reference to this.

Q. Referring to this telegram about being debarred from attending the convention, I understood you to say on your examination by Mr. Masten that you would not have gone there anyway, on account of the illness of Mrs. Martin; am I correct in that? A. Yes.

Q. Now, you said to me when I asked who debarred you, that Mr. Johnston debarred you? A. Yes.

Q. In view of the fact that you would not have gone, why did you put in the telegram the word "debarred," meaning, as I suppose, that Mr. Johnston debarred you?

Objected to. Objection overruled.

A. I discussed the matter with Mr. Wetzler, and we thought that the fact that we were not there would have a bad effect on the paper. At the same time I felt that it was not our fault, and I concluded it would be a good thing to send a telegram to the president of the association. I was endeavoring to protect the interests of the paper the best way I could.

Q. As a matter of fact, your cross examination the other day was correct where you said that Mr. Johnston had debarred you from going there? A. He had debarred me, certainly.

Q. I ask you again why you sent that telegram to the convention when you knew at the time that you could not have gone there on account of the illness of Mrs. Martin? A. Mr. Wetzler was not debarred; he signed his name as well as my own.

Q. I ask you why you signed the telegram stating that you couldn't go? A. I signed it for the reason I have just stated.

Q. Referring to the report of the Convention which Mr. Johnston sent on from Kansas City, when did you receive the first batch of that report? A. To the best of my recollection and belief, on Monday morning.

Mr. Wetzler testified that the first part of it (one-third of it) was received on Saturday, Feb. 15, and the second part on Monday morning.

Q. Whom did you receive it from? A. Mr. Colvin.

Q. Had you received any of it before that? A. I don't remember.

Q. That was a week, wasn't it, after Mr. Johnston went out there? A. I suppose so.

Q. When was the convention opened? On the Tuesday previous, wasn't it? A. I don't know; I was not there.

Q. You are not able to answer my question? A. I will give what I believe.

Q. What is it? A. I believe the convention opened at midday on Tuesday.

Q. The report began with Tuesday's proceedings? A. It ought to.

Q. As a matter of fact, didn't it? A. I don't know; I haven't any recollection about that at all.

Q. Was the report which Mr. Johnston sent you—(witness interposing) Mr. Johnston sent nothing to me.

The lawyer lapsed slightly by failing to keep in his mind the safe and reliable Mr. Colvin, and his important relations to Mr. Martin in this connection.

Q. Was the report which Mr. Johnston sent to Mr. Colvin a report of the proceedings from the beginning on Tuesday? A. I couldn't say what it was; I know there was a batch of it. To my knowledge, I couldn't say positively what that batch was; I think it was the opening of the proceedings.

Q. Now, when Mr. Johnston came to you on Monday and took the report out of your hands, can you remember whether he took out of your hands the beginning of the report, or the last of it? A. I don't remember; he took whatever I had left.

Q. Whatever you had left? A. Yes, I had filed a lot that morning. with the printers; sent a special messenger.

Q. Can you tell whether it was Tuesday's or Wednesday's proceedings that you sent to the printer's? A. I can't tell you. Mr. Colvin handed it to me; I think it was the opening day.

Q. Now, in looking at the report which was published in the issue of Feb. 22, I notice that there were a great many papers read at the convention; all those papers were sent down to the office, weren't they, by Mr. Johnston? A. I suppose so.

Q. Can you tell me when that reached your hands? A. I haven't any recollection about that, at all.

Q. It went through the hands of Mr. Colvin? A. Yes.

Q. Was there any of those papers in your hands before Mr. Johnston went out there? A. I don't remember.

Q. Are you willing to swear there were any? A. It is quite possible one or two were—quite likely.

Q. I wish you would run your eye over it and tell me which were in your hands before you went out there.

A. There is one paper here which I think I got before the report came on—the paper of Mr. Law. I think he read it to me before he sent it; I wouldn't swear to it. That's the only one I remember about. I don't say there might not be another.

Q. You spoke the other day about what we claim to be your efforts to take our employees; now you say that several of the employees came to you? A. Yes.

Q. Will you be kind enough to give me the names? A. Mr. Kornfeld, Mr. Colvin and Mr. Bouten.

Q. Who else? A. I am not sure whether Miss Menzes was with us at that time. She is with us now. And a Miss Lynch came down there, whether in earnest or not, I don't know, and asked me if I could find a position for her.

Q. Have you asked Mr. McCartie to leave Mr. Johnston's employment? A. Personally, I haven't asked him. Mr. Colvin has.

Q. Did Mr. McCartie go down to your office with Mr. Colvin? A. I don't remember. When he went there he saw me and also Mr. Colvin and Mr. Phelps.

Q. You spoke the other day about Mr. Shaw, the Boston manager? A. Yes. He is in our employ now.

Q. How did he come to enter your employment? A. The month after my discharge I went to Boston and made arrangements with him.

Q. You asked him to leave Mr. Johnston's employment and enter yours? A. It amounted to that, yes.

Q. Shaw didn't ask you for employment; you went and saw him? A. Shaw did not ask me; I went and saw him.

Q. Did I understand you to claim on the last examination that you were delayed in writing your editorials by the want of mail matter? A. Yes, very largely.

Q. And also by your want of knowledge as to what was going to be the reading matter in your paper of Feb. 15? A. Very largely.

Q. Now, I would like you to refer to the paper of Feb. 15; take the first of your editorials—"Testing Motors"? A. That's not my editorial; that's Mr. Wetzler's.

Q. Have you any knowledge as to when it was written? A. No, sir; I think it was that afternoon.

Q. Between four and five? A. I couldn't speak as to that. Mr. Wetzler, perhaps, would remember.

Q. It was not written anyway, so far as you know, until Saturday afternoon? A. I couldn't say.

Q. Do you know of any reason why the mail prevented the writing of that before Saturday afternoon? I'll tell you now that I am going over them seriatim, and have you point out how the mail affected any one of your articles there? A. I have testified that owing to the time wasted in getting this matter, I didn't get settled down to editorial matter until four o'clock in the afternoon.

Q. You don't mean to claim, then, that the mail furnished you with the subjects of the various editorial paragraphs? A. It very often did.

Q. I ask you whether you mean to claim that now? A. The paper tells for itself. Here is an item that came in that day; that strike—a little incident.

Q. Are you willing to swear that you received the information through the mail that day? A. Yes; I believe that item came in Mr. Deland's mail that day—a newspaper clipping.

Q. Is there anything else that was affected by the mail? A. It was all affected.

Q. Do I understand you to claim that the matter that come for you in the mail furnished you with the subjects in those editorials? A. *Now, I understand you; quite likely it did not. That one—"Running by the Electric Motor"—seems to be about all; that I take to be all that is strictly connected with the mail—that article.*

The artlessness of this reply: "Now, I understand you," reminds us of that of the country girl whom the Dominie reproved for kissing at the church festival: "I did not catch on to what he was at until it was all over."

Mr. Martin's own counsel had been for days trying to get him to show that the mail furnished him with subjects for his editorials, and that as Mr. Johnston maliciously kept the mail away from him he was at a loss for the subjects. During nearly all the same time the defendant's counsel had been trying to show that this was not so, and just as the efforts of the learned gentlemen were about finished, and Mr. Martin had been requested to go over the articles seriatim and point out how the mail affected each, he got to that state where he could say: "Now I understand you."

What a pity it took Mr. Martin so long to "catch on." However, when he did "catch on," he admitted that only one editorial was "strictly connected with the mail"; and the paper shows that that is a composition of just twelve lines in length.

Q. I understand you simply claim that your efforts to secure the mail had wasted so much of your time on Saturday that it prevented you from going on—(witness interposing). A. From getting the other editorials done.

Q. All the rest? A. Practically all the rest.

Q. Wasn't it possible while you were waiting for the mail you could have written all the editorials? A. I was not waiting; I was hustling.

Q. Where were you on Feb. 8? A. At the printing office and our own office.

Q. How often were you at your own office? A. Only once.

Q. How long would it take you to go over there and get back to the printing office? A. I was away about an hour.

Q. When you were over to the printing office for about that hour did you ask Mr. Johnston for the mail? A. Mr. Johnston wasn't there, I believe.

Q. You swear that Mr. Johnston was not in the office in the forenoon? A. I can't swear, but I believe he was not.

Q. Now, I say, did you ask him for the mail matter? A. To the best of my belief, he was not there.

Q. Then, you made no efforts to find Mr. Johnston? A. I made no effort, because I believed he was not there.

Q. Did you make any inquiry for him? A. I did.

Q. Of whom? A. Mr. Colvin.

Once again "the safe and reliable."

Q. Was he the only one? A. I went to Mr. Stump about it.

Q. What hour was it you were at Mr. Johnston's office? A. I believe it was about half past nine.

Q. Were you there any time after half past nine? A. I left there a little after ten.

Q. And you were not there at all afterward on Saturday? A. I don't recollect any time at all; I might have been, but I don't remember it.

Q. Well, after you left the office at half past nine or ten o'clock, as you say, you made no further efforts to find Mr. Johnston until he appeared on the scene. A. Oh, yes, I did—I beg your pardon.

Q. What were they? A. About half past four I telephoned over to the office and asked if Mr. Johnston was there, or Mr. Stump.

Q. Who answered you? A. Mr. Colvin.

Q. You are sure it was as late as half past four? A. That was the time. It was right at that time; it might have been a few minutes before.

Q. Had you any way of communicating with the office between ten o'clock and half past four? A. I was telephoning all day.

Q. Who answered you every time you telephoned? A. Mr. Colvin or Mr. Stump.

Q. Either one? A. Those were the men I sent for.

Q. You did not at either time ask for Mr. Johnston on the telephone? A. No, sir.

It is not necessary to make any comment on the amount of time Mr. Martin "wasted" to get the mail, "hustling," as he calls it, as shown by this testimony. Every time the lawyer got him at anything like close range to the facts Mr. Colvin bobs up serenely. Mr. Colvin did say, however, in his testimony that Mr. Martin telephoned him about the mail *two or three times.* Mr. Martin now says he was telephoning *all day.* He did not, however, get, or try to get, in communication with Mr. Johnston. This he admits. Mr. Wetzler could not tell what matter or mail was late. He did testify, though, that Martin was telephoning to Colvin about it all morning—"two dozen times," he says. The number of telephone messages was evidently growing. Which of these three was correct about this we cannot say. It was a sort of family secret between them, but all of them could not be correct.

Q. On this 8th of February couldn't you have put the paper to press without the notes which you speak of as the Western and New England notes? Answer yes or no? A. Could I have done so? Yes.

Q. Was there ever an occasion before, when it was put to press, when you had to await a portion of the matter which came in late? A. Oh, yes. I left out a lot of it.

Q. And had you frequently before? A. Yes, it happened nearly every week.

Q. And why didn't you put it to press on Feb. 8, without awaiting the matter which was not handed to you at that time? A. Because the disposition I framed of the matter prevented it; a great deal of the matter was essential to get in, and I had made provisions to get it in; and I intended to have it in.

"Because the disposition I had framed of the matter prevented it." This is a brand new explanation. Up to this point the excuses were the "delay of mails," "the printers not ordered to work overtime," "the time wasted in hustling after the mail." From all these disturbing causes we had supposed Mr. Martin had not been able to frame any "disposition of the matter" at all.

Q. On Wednesday before the 8th of February, there was a meeting of the Board of Directors? A. Yes.

Q. There was some talk, wasn't there, among the members of the board at that meeting about the paper going to press on Saturday? A. I don't remember that. I don't think there was.

Q. Do you remember any suggestions which you made at the meeting of that board as to having the Board of Directors express the opinion that you should go out to the Kansas City Convention in opposition to Mr. Johnston's wishes? A. I took no action whatever at that particular time looking to my going to Kansas City, or seeking my going there.

Q. I ask you if there was some suggestion on your part in reference to getting some expression from the board? A. I took no action whatever.

Q. Did you give any expression to your feelings? A. None whatever, about my going; I didn't want to go.

Q. Did you give expression to such feelings as to the editorial department? A. I have.

Q. Who was the editorial department? A. Mr. Wetzler and myself.

Q. Haven't you frequently requested printers to work overtime on occasions previous to this 8th of February? A. Never without consultation with the office.

Q. Why didn't you ask them on the 8th of February to work overtime? A. Mr. Johnston took the paper out of my hands before the moment arrived that I should do it. I telephoned over to the office about half past four, to find out what should be done; Mr. Johnston jumped on me.

Q. You say on this 8th of February when you telephoned to the office word came back to you that Mr. Johnston was not there? A. No, I don't remember testifying that.

Q. Well, now, did word come back to you that Mr. Johnston was there? A. I am under the impression that such was the communication. Mr. Colvin replied to me, and I am under the impression that was the message.

Q. That Mr. Johnston was in the office? A. Not that he was in the office, but that he was either coming back or going to the printer. Just what they said I don't know, but I don't think he was in the office. It was an answer that conveyed to my mind the idea that he was somewhere around.

Q. As a matter of fact, you couldn't reach Mr. Johnston? A. No, I didn't reach him.

Q. You couldn't reach him after all your efforts? A. I telephoned.

Q. You were not successful in reaching Mr. Johnston after all the efforts you made? A. Let it go that way.

Q. Did you consider, then, in view of that fact, that you couldn't, or did not, succeed in reaching Mr. Johnston, that you had to wait there until five o'clock for orders from Mr. Johnston?

Mr. Masten: I object to the question. Objection overruled.

A. I was not waiting; I was working all the time. There was no waiting about it; we were pitching in as hard as we could go.

Q. Won't you answer my question? A. I don't understand what you are driving at.

Question repeated by the stenographer.

A. Yes, I considered that if I ordered those men to wait there I ought to have some sanction from the office, because it meant to have the press room work at night.

Q. Weren't you vice-president of the company at that time? A. I was.

Q. Haven't you on all prior occasions when Mr. Johnston could not be reached acted in Mr. Johnston's place? A. I don't remember any future occasion of that kind.

Q. Are you able to refer to any occasion on which you acted when Mr. Johnston was absent? A. When Mr. Johnston was absent, yes; when he was away traveling but not when he was in the city, and supposed to be running the business.

Q. Did you feel on that occasion that you were not warranted in taking the responsibility of telling those men to remain there and put the paper to press? A. I felt entirely that way, for the reason that Mr. Johnston had taken all power away from me, and withheld even my own personal letters, let alone the office letters. He clipped my wings just as close as he could clip them.

Q. During the hours you were waiting there for Mr. Johnston to come from the printer, did you make any complaint? A. I did not. I called for Mr. Johnston at half past four, and awaited him immediately afterward in the sense of expecting his presence.

Q. Haven't you already testified that you telephoned in the morning? A. I have not testified to any such thing.

Q. You did not telephone for him at all before half past four o'clock? A. No, sir.

Q. Are you positive about that? A. Yes, I am positive that I did not telephone for Mr. Johnston at any time during that day until half-past four o'clock. I telephoned to other people.

Q. Why didn't you make some effort to find Mr. Johnston before half past four o'clock? A. Mr. Johnston had so entirely turned the cold shoulder to me that there was no doing any business between us.

Q. There was a great deal of ill feeling between you and Mr. Johnston at that time? A. Yes, have it that way if you want to.

The Referee: Is it true? A. I was doing my best, Mr. Referee, to maintain—

(Referee interposing): The question is whether there was any ill feeling between you?

Mr. Masten: I submit the question has already been responsively answered, and unless it appears more definitely what is in the questioner's mind and what there is in regard to the ill feeling, I object.

Objection overruled.

A. I can't answer.

Mr. Keigharn: I appeal to you, Mr. Referee, to make him answer the question.

The Referee: I can't make him answer, Mr. Keigharn.

Mr. Keigharn: I suppose you have powers of compulsion, and I ask you to exercise them.

The Referee: I can't give the witness capacity. The witness can't say whether there was any ill feeling between them or not.

Mr. Keigharn: I don't so understand it. He says he can't answer the question.

The Referee (to witness): What do you mean by that? A. If Mr. Keigharn means by "ill feeling" bad feeling, I have not.

Q. What do you mean when you say that you can't answer the question? A. That I was doing my best, and trying to be as resigned as I could.

Q. Please answer, according to the best of your ability, whether at the time of which you are questioned was there any ill feeling between you and Mr. Johnston? A. I have said all that I can say in answer to that question. If patience is ill feeling, yes, under vindictive torture.

Q. When you were suffering from all this vindictive torture, was there any resentment at all on your part as to Mr. Johnston's vindictive conduct toward you? A. In the way of hitting back—no, sir.

Q. And you were always submissive? A. I was doing my level best to be so.

Q. And there was no resentment? A. There was indignation, and a very intense one, I assure you.

Q. And you had not, at any time, given any definite expression to it?

Mr. Masten objected to the question, unless limited to some specified time or place. Objection overruled.

A. I was very frank in my avowal of what I thought.

Q. To Mr. Johnston? A. I think so, probably.

Q. In what form were your avowals made? A. In writing and by word of mouth.

Q. Are you able to recall anything you ever said to Mr. Johnston by word of mouth in which your resentment was expressed?

Mr. Masten objected. Objection overruled.

A. I don't recall any definite expression; I know there were expressions. I tried to reason with him.

Q. When you said a few minutes ago that you gave very free expression to your feelings, or words of that kind, what had you reference to? A. These various acts of Mr. Johnston.

Q. What had you reference to as to your own words when you said you gave free expression to your feelings? A. I filed a protest for one thing.

Q. Anything else? A. The matter was discussed among us in board meetings; not outside.

Q. Did you ever say anything to Mr. Johnston himself which was outside of the meetings? A. Mr. Johnston and I were never together alone after some time in December, that I remember.

Mr. Martin had ill feeling, or an "intense indignation" as he once called it, against Mr. Johnston at this time, and he made "very frank avowals of what he thought" to Mr. Johnston, both by "writing and word of mouth." He could not be coaxed to tell what the writings were which conveyed his "very frank avowals." No doubt they were the letters which we have published in fac-simile, although he would not admit it. Whatever they were, they were called forth by "vindictive torture," we suppose at the hands of Mr. Johnston, and under "intense indignation."

These are high sounding words, but why did he not come down to plain facts and tell, if it was possible for him to tell, one word which Mr. Johnston had ever said to him which was offensive, or one action which Mr. Johnston had ever committed which was sufficient to cause him to feel indignant.

At no time during his whole examination did he disclose specifically any one word or act on Mr. Johnston's part which could be construed into any thing which was meant as an insult, or to which he could take exception or offense.

Mr. Martin is not so much of a simpleton that if he knew of the existence of one such word or act he would have omitted to disclose it. He knew too well how important it would have been to him to have laid bare in the plainest manner all of Mr. Johnston's offensive conduct toward him, had any such thing ever existed—how absolutely it would have been to his advantage in this litigation, as an excuse for the feelings which he admited existed on his part.

From the absence of any such disclosures an intelligent mind can draw only one inference—that there was no cause for Mr. Martin's ill feelings, and that no indignation existed on his part. The feelings were produced by entirely different causes than he suggested, and the indignation was simply a sham put forth, if it was put forth at all, for a purpose.

Q. Why did you not telephone for Mr. Johnston before half-past four o'clock? A. Because I was telephoning to his representatives, Mr. Stump and Mr. Colvin.

Q. You made no personal efforts to reach Mr. Johnston by going to his room to find if he was there? A. I did not.

Q. Your efforts were confined entirely to telephoning Mr. Colvin? A. And Mr. Stump. I told the boy that I wanted Mr. Colvin or Mr. Stump every time.

Q. All your communications were with them? A. Yes.

Q. Can you recall any occasion, Mr. Martin, prior to this 8th day of February, when it became necessary to have personal instructions from Mr. Johnston as late as four o'clock in the afternoon of the day when the paper was going to press?

Objected to as not confined to the particular matter in issue. Objection overruled.

A. I don't remember any such occasion.

Q. Can you tell me why on that day you did not either go to see Mr. Johnston, in view of the fact that you wanted to see him so badly; or send a messenger to him? A. I wasn't hunting Mr. Johnston. I telephoned over to the office for instructions. I asked for Mr. Johnston, and I got the impression that he was there, or coming over.

Q. From whom did you get the impression? A. Either from Mr. Stump or Mr. Colvin.

Q. You have testified before that as a matter of fact you made no request of the printers to remain there that night? A. I don't recollect what I have testified; I am willing to testify now.

Q. What is the fact about it? A. I went to Mr. Newman and asked, and as the result of that interview I called up the office at half past four, feeling that it would be necessary.

Q. After half past four you made no further request of Mr. Newman? A. Mr. Johnston came there.

Q. You made no further request.? A. I was through when Mr. Johnston came.

The Referee: You made no further request? A. I made none.

How did this issue, bearing imprint of Feb. 15 (that you were working on the 8th), compare in size with the ordinary issues of the paper? A. It was a great deal larger.

Q. In what respect? Reading matter? A. Reading matter and advertisements alike. I should say it was perhaps 25 per cent. larger (possibly more) than the regular issue.

Q. Did that increase, in any way, the labor on your part of getting the paper ready to go to press and putting it to press? A. Proportionally, very decidedly. In fact, the labor increased perhaps out of proportion.

Q. And did the fact that the paper was going to press earlier than usual have any effect upon the amount of labor required of you? A. Yes, a great deal; we were two days ahead of the time. The advertisers in the paper were largely friends of mine.

Q. To what extent, if at all, were you instrumental in securing their advertisements for the paper? A. I did a great deal to secure the advertisements for the paper.

Q. And to what extent were the contributors to the paper friends of yours? A. Friends of mine; in fact, a large proportion of the contents of that number I had especially obtained for that issue.

Q. With regard to this telephoning to the office, did I understand that you telephoned both to Mr. Stump and to Mr. Colvin for the mail matter? A. Mr. Johnston had taken it away from me and put it in the hands of Mr. Colvin, and I had to go to him, although he was a subordinate.

Q. Did Mr. Colvin at that time send you the mail matter? A. Yes.

Mr. Keigharn: Was the issue of Feb. 15 larger than any of your prior convention numbers—larger than the papers that went to other conventions? A. Quite likely; I couldn't answer off hand.

Q. Are you willing to swear it was larger than the usual convention paper? A. I am willing to swear that I believe it was; I couldn't speak until I look it up.

Q. As a matter of fact, you went to press earlier for the purpose of meeting the extra labor which it would entail? A. That it would entail.

Q. And so you went to press on this number of Feb. 15 earlier than usual for the purpose of giving you an opportunity to put it out because it was larger? A. We went to press earlier to get to Kansas City.

Q. Do I understand you to say that when you telephoned Colvin he declined to send you around the mail matter? A. You do, distinctly.

Q. Did you ever make any complaint to Mr. Johnston about his so declining? A. No, sir. He was doing it under Mr. Johnston's orders; what was the use of my objecting.

Q. Did you know that? A. I did. He told me so every day in the week. Mr, Johnston kept the whole mail away from me, although I was the editor of the paper.

Frank E. Knight, on behalf of plaintiff, examined by Mr. Masten, testified that he was at one time a stockholder in the W. J. Johnston Company, from about March 1, 1890, to sometime in December of the same year; he obtained his stock from Mr. Johnston and gave it back to Mr. Johnston. The consideration between him and Mr. Johnston was a nominal one, and he received no value for the stock when he returned it to Mr. Johnston.

Cross examined by Mr. Keigharn: I held five shares of the stock. I did not pay anything for it. I supposed it was given to me to qualify me as one of the officers of the company, and when I transferred it back to Mr. Johnston there was nothing paid to me. I made Mr. Martin's acquaintance at the time we returned from the Kansas City convention, I think on Monday, which would be the 17th of February, 1890.

Q. How did you make his acquaintance?

Mr. Masten: I object. Objection overruled.

A. I saw him about the office; I don't think that I was introduced to him formally.

Q. Can you recall where you first saw him in the office? A. No, sir.

Q. Was Mr. Johnston present when you first saw him? A. I couldn't recall that either.

Q. Can you recall anything that happened? A. Nothing more than I saw Mr. Martin there.

Q. Are you quite sure now, Mr. Knight, that you are unable to recall Mr. Martin's remarks?

Mr. Masten: I desire to have it understood that my objection to this line of testimony is general, without repetition on my part.

A. I can remember when we came back from the Kansas City convention that there was a scene between Mr. Johnston and Mr. Martin.

Q. What day was that? A. I couldn't specify the day; when we first returned. I was new in the office, and it happened there during the first day or two after I returned.

Q. You recall there was a scene between Mr. Johnston and Mr. Martin, you say. A. Yes.

Q. Can you recall what Mr. Martin said? A. What I remember is that there was some talk about the way in which the matter came from Kansas City for the following edition of the paper.

Q. What do you refer to as "matter"? A. The matter of the doings at the convention.

Q. The report, you mean? A. Yes; and that Mr. Martin said that heretofore in convention issues the matter had been sent in edited, whereas this had come without being edited, and had to be gone all over.

Q. Can you recall any more explicitly as to what Mr. Martin said when he made complaint about the manner in which that was edited? A. He said the whole matter of reporting this convention, and attention to this convention, had been different from that of others, and that he couldn't take that matter as it had come in and prepare it for publication with the same dispatch and facility that he had the others.

Q. He complained of it being muddled; wasn't that the word he used? A. I can't remember the exact word.

Q. Didn't he claim the efforts to report had been a "bungle," or something like that? A. I don't know that he used those words, I don't remember.

Q. Was the substance or the meaning of his remarks the disparaging of the report? A. The meaning of the remarks was that heretofore he and Mr. Wetzler as editors of the paper had been attending to the conventions, and had sent the matter so that it was in shape for publication, and that it had not been done so and so.

Q. Did he find fault with Mr. Johnston because it was so? A. Find fault with Mr. Jonnston? No; not that I know of. He found fault with the matter.

Q. Was Mr. Martin angry at all when he made those remarks? A. I couldn't tell.

Q. Now, Mr. Knight, those remarks that you have just been referring to were made on the day of your return from Kansas City, weren't they? A. No, sir.

Q. How long after that? A. We returned from Kansas City on Sunday, right here in New York.

Q. You were in the office the following Monday, weren't you? A. Yes.

Q. Were the remarks which you have just testified about made on Monday? A. I stated that I couldn't tell just which day they were made, whether it was Monday or Tuesday.

Q. Now, I don't want to be at all captious, but I want to get the fact, because I think it important. Did you meet Mr. Martin on any day before the remarks which you have testified to were made? A. Do you mean was it at the the first meeting of Mr. Martin that these remarks were made?

Q. Yes; just about the same thing, probably put a little better. A. I couldn't tell that.

Q. Now, do you recall that when you met Mr. Martin for the first time the meeting occurred in the private office of Mr. Johnston? A. No, sir; I don't recall the fact that it did, although it may have.

Q. Do you recall the fact, Mr. Knight, that Mr. Martin, immediately after going into the office, made some complaint that he had not been made acquainted with you? A. I do—now that you speak of it.

Q. Do you recall the fact, also, that Mr. Martin on that same occasion said that if you came there to work you would find out the man Mr. Johnston was?

Mr. Masten: I still fail to see the relevancy and propriety of this testimony.

The Referee: I do not, but I assume that Mr. Keigharn has a purpose in view.

A. Yes; I think Mr. Martin made some remark of that kind at some time.

Q. Did he also say in the presence of Mr. Johnston to you that if you worked for Mr. Johnston you would find out that he would deceive you as he had him, and that he was not to be trusted, or words to that effect? A. Whether this occurred at that time is a question in my mind—I don't remember that.

Q. Let the time go for the present, and say whether he ever made such remarks in your presence? A. I have heard Mr. Martin express in substance about that.

Q. In Mr. Johnston's presence? A. In Mr. Johnston's presence.

Here is evidence, forced from Mr. Martin's own witness, of an insult from him to Mr. Johnston of the grossest kind. There was no provocation for it. Mr. Martin has never even offered an excuse or explanation; yet he had no hesitation in swearing that he always treated Mr. Johnston with respect. This insult alone was sufficient grounds to justify Mr. Martin's discharge on that instant.

Re-direct examination by Mr. Masten:

Q. What time did I understand you to say it was that you became connected with the W. J. Johnston Company, Limited? A. On the 10th day of February, 1890.

Q. Do you recollect being present in the office at or about the time when Mr. Martin was discharged from the employment of the W. J. Johnston Company, Limited? A. I was connected with the company and in the office, I think, at the time.

Q. When was it relatively to the time of Mr. Martin's discharge that you heard him make these statements to Mr. Johnston in your presence to which you have testified—I refer to the statements to the effect that if you stayed in the employment of the company that Mr. Johnston would deceive you as he had deceived him? A. When was it relatively to his discharge?

Q. Yes. A. Well, the precise time when Mr. Martin made those remarks I couldn't say. I think I testified that I could not. I don't know whether it was on the first day or the second day when we came back from Kansas City, or whether it was as far removed from that time as when the meeting occurred.

Q. What meeting? A. The meeting for the election of officers for the ensuing year.

Q. Do you recollect how long it was after you were in the office of the W. J. Johnston Company before you met Mr. Martin? A. The first week that I was in the company was spent in Kansas City; that is, the week beginning Feb. 9, Sunday, and ending Feb. 16; and I returned and went to the office the following Monday morning. I think hat I met Mr. Martin on that day.

Frederick Deland, called for the defendants, examined by Mr. Keigharn.

I am the manager of The Electrical World branch office in Chicago. I introduced Dr. Bell to Mr. Johnston on Feb. 10, 1890. I knew that day that Mr. Johnston was seeking to employ Dr. Bell as editor of the paper. The arrangement for his employment was completed on March 11. Between Feb. 10 and March 10 negotiations were going on for his employment. I have known Frank R. Colvin for four or five years. I met him in Chicago in November, 1890.

Q. What did he say to you in reference to anything in connection with the "Electrical Engineer" or The Electrical World?"

Objected to as immaterial. Overruled.

A. He spoke of Mr. Martin and Mr. Wetzler and his connection with the paper, and he said they expected to get more satisfactory results from their work in the West hereafter, and that he had been talking to one of our advertisers there, and had called his attention to the fact that he was paying more for an advertisement in The Electrical World than Eastern parties were; and when I expostulated with him that that was an unfair method of doing business, he said he was there to accomplish his ends irrespective of any detrimental effect it might have on the World. When I asked him how he knew that this low rate had been paid, he said he had had access to the contracts, subscriptions, etc., and that in making this statement to the Western advertisers he had indicated that he had this knowledge at hand, and that he was thoroughly posted on the subject; in other words, he was using information that belonged to The Electrical World that would injure it.

Mr. Colvin never had access to the books or papers of the company as late as November, 1890. He left the World in March, 1890; but Mr. Martin had access to these books and papers in November, 1890, because his representative, Mr. Morton, made an examination of the books in that month, as he testified. The use Mr. Colvin was making on behalf of the "Engineer" of the knowledge obtained from our books, and which he said he had at hand, lets in a great deal of light on the subject why Mr. Martin wanted to examine the books as a "stockholder." Mr. Colvin was not called to dispute or explain this testimony of Mr. Deland. The wisdom which guided Mr. Martin's case apparently kept in view the net results realized to Mr. Martin by the testimony of Messrs. Knight and Stump.

Q. Did he make any threats of any kind as to what he would do?

Same objection; overruled.

A. He made a remark that he was going to carry on a decisive warfare against the World in the interests of the "Engineer"; I don't know that that is a threat.

Q. Have you had any communications from Mr. Colvin in reference to your leaving the employment of the World? A. Yes, sir.

Q. Before November, 1890—in any part of the year 1890—had you anything in the way of a dispatch or letter from him? A. Yes, I had a dispatch from Mr. Colvin from Boston. The substance of it was—

Mr. Masten: I object to the manner of proof. If he has the dispatch, I have no objection to his reading it.

Q. Can you fix the date about when you received the dispatch you refer to? A. It was some time in March, about the first of March; I judge from the 1st to the 15th. I can't say positively. I presume the dispatch was destroyed among a great many papers which I destroyed when I left Chicago.

Q. Give us the substance of it as nearly as you can remember? A. "We have Martin and Wetzler, two stenographers and a clerk, and I have just secured Shaw and wish you would join us."

Q. Whom did you understand that Mr. Colvin referred to in the dispatch when he said he had secured two stenographers and a clerk? A. That he had secured from The Electrical World office two of its stenographers and a clerk who were all formerly employed in the same office with him. I was in the habit of sending to The Electrical World letters which were published from time to time, and which were known as "Western Notes." Some of these notes for the issue of Feb. 15, 1890, were sent on Saturday, Feb. 1, and some on Monday, Feb. 3, and the balance on the next day, Feb. 4. There were no notes or articles of any kind for publication in the issue of the 15th sent after the 4th of February to my knowledge. I was at the convention at Kansas City. The convention opened on Tuesday morning, Feb. 11, and closed Friday afternoon.

Cross-Examined by Mr. Masten:

I first introduced Mr. Johnston to Dr. Bell on Feb. 10. Negotiations were in progress continuously from that time until along in March for the employment of Dr. Bell. I partly carried on these negotiations. The proposition to Dr. Bell was to do editorial writing. I did not understand that he was to take the place of Mr. Martin or Mr. Wetzler. I first knew that he was to take Mr. Martin's place after I heard Mr. Martin was no longer with the World. The arrangement between Mr. Johnston and Dr. Bell was finally consummated on March 11 in Chicago. When Dr. Bell met Mr. Johnston on his way to Kansas City the subject of Dr. Bell coming to take a position on the World was discussed, and preliminary steps taken. The conversation with Mr. Colvin on the subject of advertising to be secured by him for "The Electrical Engineer" was on the 26th of November, 1890, at the Grand Pacific Hotel, Chicago. As to the telegram I received from Mr. Colvin from Boston, I am not able to fix the date. It was some time in March; it was just about the time the Engineer was converted into a weekly. The Western Notes were sent as I have testified, on Feb. 1, Feb. 3 and Feb. 4. I had received instructions that nothing would be inserted in that issue unless it left Chicago not later than Feb. 4, which was Tuesday—that it must be in New York office on Thursday of that week. I find it as a matter of record in the letter book that I did send such letters.

Redirect Examination by Mn. Keigharn:

What you hand to me is a copy of the telegram sent to Kansas City Convention informing me that the papers had been shipped on Feb. 11. It is in the handwriting of Mr. Colvin, and is as follows:

Feb. 11, 1890.

C E. Stump, Coates House, Kansas City, Mo.

Am shipping you one hundred copies complete edition fifteenth by express. Hope that is enough. Everything lovely. Colvin.

Re-cross-Examination by Mr. Masten:

When I sent a copy and notes from the Chicago office they were sent to The Electrical World, and they were usually acknowledged from the business office. While I was in charge of the Chicago office I never had any occasion to complain of any lack of attention or promptness on the part of Mr. Martin personally. I complained that notes were left out from time to time—notes that advertisers expected would go in.

To the Referee: There was several times each year when it would occur.

To Mr. Masten: I said I thought this omission was not a personal matter with Mr. Martin.

By the Referee: I understand that you sent out notes from the West to be inserted in the World, and from time to time they failed to be inserted in the World, and somebody was at fault? A. Yes, sir.

Q. The complaint was against the omission, not against the particular act of any individual? A. That was it. I would say the notes would probably appear in the paper one week later; and when I did complain it was because they did not appear the week before, instead of the week following.

To Mr. Masten:

I am not able to fix the responsibility. I am still in the employ of the W. J. Johnston Company, and have been for some time.

Redirect by Mr. Keigharn:

The notes which I sent to the office of The Electrical World were always acknowledged by the business office as a rule. At that particular time I think it was Mr. Colvin who wrote the letter of acknowledgment.

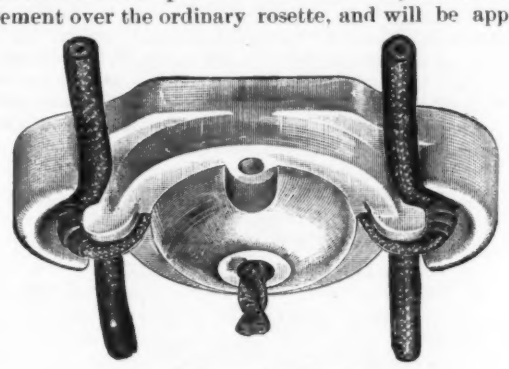
Train to the Milwaukee Convention.

Arrangements have been completed for special transportation to the convention of the American Street Railway Association at Milwaukee (Oct. 18–20) via the New York Central & Hudson River Railroad. The train of Wagner vestibuled sleeping cars, with dining car attached, will leave the Grand Central Station at one o'clock p. m. on Friday, Oct. 13, arriving in Chicago the next day at two o'clock.

The fare for a round trip from New York to Milwaukee will be $43.60, adding $5 for berth each way to and from Chicago. This rate applies to those starting from New York. Special rates will be given to those joining the party en route. The object of leaving at this time is to enable the delegates to spend two or three days at the World's Fair before attending the meeting, and likewise after the meeting, if desired, thus making an agreeable break in the labor of sight-seeing at the Fair. In order to be provided with accommodations on this train, it is necessary that the amount for the ticket from New York ($48.60) should be sent at once to T. E. Crossman, American Street Railway Association, 166 Montague street, Brooklyn, who will assign a berth and send the ticket.

A Fuseless Rosette.

We illustrate below another useful addition in the form of a fuseless rosette to the very desirable line of Hammond specialties, cleats and insulators manufactured by the Hammond Cleat and Insulator Company, Boston, Mass. The ears or binding flanges, it will be seen, furnish a perfect protection where the insulation is cut, and completely separate the wire from the woodwork or plastering on which the rosette is placed. This is a very desirable improvement over the ordinary rosette, and will be appreciated by insurance underwriters, while wiremen will find it convenient for putting up as well as neat in appearance. The rosette is adapted to molding as well as to cleat work.



A FUSELESS ROSETTE.

Recording Voltmeter for Alternating and Direct Current.

For some time there has been a demand in electric light and power stations for a voltmeter which would make a continuous record day and night of all changes of voltage.

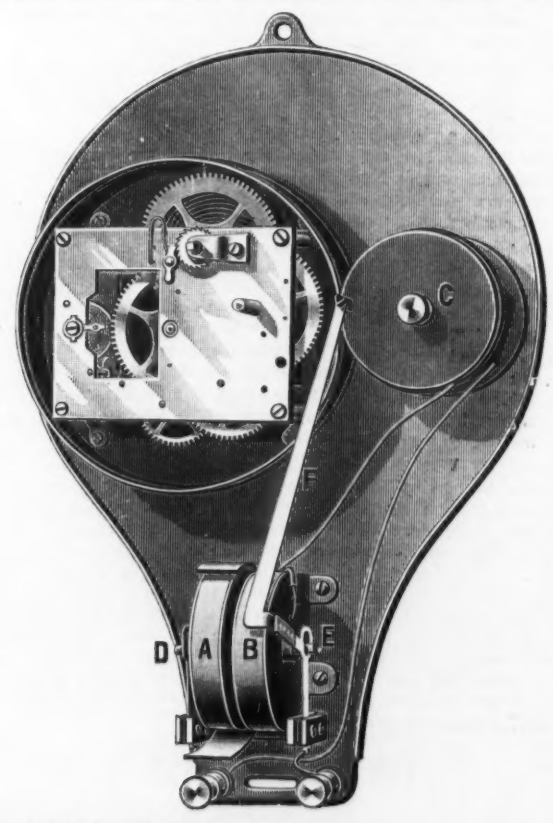
It has been shown by tests that the life and efficiency of incandescent lamps is greatest when the voltage is evenly maintained. When it rises above that for which the lamps are designed, even though the lamps may not be burned out, they are liable to be seriously injured. If voltage falls below the normal the result is deficient illumination and dissatisfaction of consumers.

In the accompanying engraving we illustrate a new recording voltmeter which is being manufactured by the Bristols' Manufacturing Co., of Waterbury, Conn. This instrument has been designed with a special view of being simple in construction and sensitive and accurate in its operation.

Fig. 1 represents the voltmeter ready for connection. Fig. 2 shows the interior construction. The coil *A* is mounted on the spring knife edge supports *D* and *E*, and is free to move toward the parallel and stationary coil *B*, when they are mutually attracted to each other by a current passing in series. The current is conducted to the movable coil *A* through the supporting springs *D* and *E*, and this, together with the special nature of the moving coil, being mounted on frictionless spring knife edges, renders the instrument extremely sensitive to the smallest changes of voltage. The marking arm *F* is attached directly to the spring *E* and partakes of its motion, recording the changes of voltage on a uniformly revolving chart. It will be observed that the instrument is constructed on the electric balance principle without electromagnets.

The divisions on the chart are on an increased scale in the vicinity of the voltage to be maintained, thereby making it possible to note the variation of one volt. The chart shown, in Fig. 1 is intended for a 110-volt circuit, but the instrument is equally well adapted to any other desired range of voltage, as for instance one of 600 volts for electric railway work. The coil *C* is an auxiliary resistance. With the alternating current voltmeter the auxiliary resistance is furnished in a separate rheostat which may be adjusted to suit the rate of alternations of the current to be measured.

At the World's Columbian Exhibition the Bristols' company has one of the instruments in operation at its exhibit in Machinery Hall, and one in Electricity Building. Two of the voltmeters are being used by the Committee on Awards in connection with the life tests of incandescent lamps.



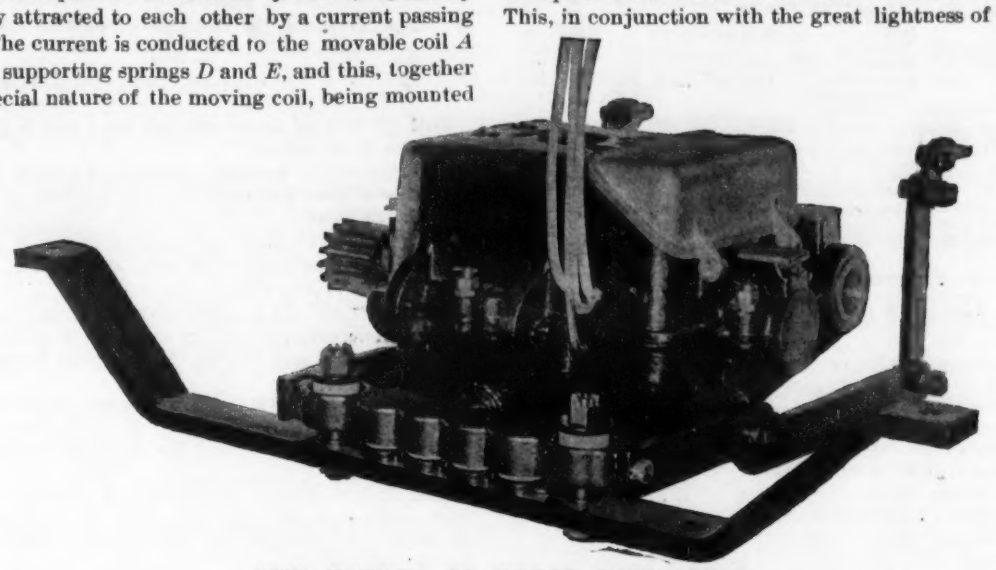
FIGS. 1. AND 2.—NEW RECORDING VOLTMETER.

A New Method of Motor Suspension.

Among recent improvements in street railway practice is a new method of suspending the motor on the axle and the truck, whereby it is made to rest upon a resilient system, the weight being supported at a point immediately below the centre of gravity of the motor itself. This system of suspension is employed in the new G. E. 800 street car motor of the General Electric Company, and is known as the cradle suspension.

Referring to the accompanying illustration, it will be seen that immediately below the armature bearings are trunnions on each side of the motor, set in side bars which are pivoted at the front to a special casting and supported at the rear end from link bars bolted to the truck frame. The front special casting is mounted upon six springs, two of which offer resistance to pressure upward, and four resistance to the downward pressure.

It will be seen that this modification in the system of motor suspension is of significance in electric railway practice. The motor being set upon a spring like cushion, the greater part of the dead weight is taken off the axle and more evenly distributed to the axle bearings and to that part of the truck which can best stand the strain. This, in conjunction with the great lightness of the motor means great economy in track maintenance and a decrease in the possibility of accident to axles. A series of careful tests has already proved the value of the improvement, which promises to become general where the G. E. 800 is used. This method will be seen at the Milwaukee Convention, when the street railway engineers will have a good opportunity to examine it.



NEW METHOD OF MOTOR SUSPENSION.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 7, 1893.

THE COURSE OF THE ELECTRICAL STOCK MARKET cannot naturally be gauged by the ups and downs that mark the doings in one or two special quarters. The causes bearing upon these certain stocks are of specific influence, and they by no means are an indication or a reflection of how the electrical trade is to-day situated. The improved tone spoken of in former letters continues more and more marked. There has been a yielding in quotations that isn't exactly in accordance with the cheerful prognostications made in behalf of the electrical trade, but this is after all a side affair; it does not truly reflect the really healthful conditions that actually prevail.

GENERAL ELECTRIC has suffered again as a result of the vicious drives made against the stock's quotation by the now carefully organized bear party. The campaign against the stock is being conducted on most vigorous lines, and the leaders find in the uncertainty regarding the next dividend a good weapon to smash the stock's quotation. Sources that profess to be in touch with the insiders are authorities for the statement that the next dividend will be passed. Wall street is disposed to accept this statement as a literal fact, and it is on this that the bear crowd puts its chief reliance. Boston is still the headquarters for the most savage innuendos and reports discrediting the company that are now in circulation, and it may be that the disappointment felt in certain Eastern quarters at the failure of one or two cherished plans to so control the General Electric Company as to give Boston the greatest advantages in any stock market deal has had a good deal to do with the venom displayed in the recent attacks on the company. The General Electric Company has admittedly been hard hit by the bad times. In addition it has had to suffer from dissensions among insiders, one party of which from purely selfish interest has been doing everything in its power to injure the company's credit. It is not necessary to criticise the causes leading to the depreciation of the stock; the mischief has been done, and the stockholders' chief concern now has to do with the rehabilitation of the General Electric Company. If the keeping of the next dividend in the treasury will help put the company solidly on its feet again they will not murmur.

THE ELECTION OF THE ELDEST SON of the late F. L. Ames to his dead father's seat in the General Electric's board of directors insures the continuation of the Ames interest in the company. It means that the big Ames holdings will not come on the market, that the Ames subscription to the floating debt will be adhered to, that the Ames millions will continue to be at the disposal of the company. The late F. L. Ames trained his sons to a perfect sympathy with his plans and wishes, and it can be relied upon that every single one of them will be carried out to the letter by his heirs.

WESTERN UNION TELEGRAPH stock continues to be pressed for sale every time any strength is displayed. Just where the selling comes from is hard to discover. There is justification for feeling bearish on the stock in view of the continued reports of decreasing earnings and of destruction to property by reason of the recent severe cyclonic storms. Strenuous efforts are being made to increase the volume of business by offering inducements to lessees of private wires and in other ways. Expenses are also being cut down in every possible shape. Of course there is no danger of lessened dividends, and for this reason real investors have refused to part with their holdings.

WESTINGHOUSE ELECTRIC PREFERRED has showed bearishness at times during the week. Nothing concerning or affecting the company's welfare has been made public to warrant this. The explanation lies in the fact that a block of the stock that has been carried for some time has at last been pressed for sale at the expense of quotations. The business of the company is reported to be picking up with a steadiness that presages its continuation.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburgh, has declared a quarterly dividend of 1½ per cent., payable Oct. 10.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	92	93
" " " 1sts	...	95	96
Edison Electric Ill., Brooklyn	100	95	100
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2½	5
" " Bonds	..	80	85
" " Ore Milling	..	5	12
Fort Wayne Electric	..	4½	5½
General Electric Company	100	44¼	44½
" " deb. 5's	..	80	81
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	21	21½
" " pfd	50	40	42

AFFAIRS OF THE COMPANIES.

THE NIAGARA FALLS "GAZETTE" says that by means of a bill passed by the State Legislature last winter the Niagara Falls Light and Power Company expects to use the canal banks for conduit purposes. It states that the moneyed men behind the company are: Drexel, Morgan & Co.; W. K. Vanderbilt, Winslow, Lanier & Co.; D. O. Mills, Brown, Brothers & Co.; Morris K. Jessup, August Belmont and Isaac N. Seligman, and that already $5,000,000 have been spent on its plant, and at least twice as much more is to be spent.

THE WENSTROM ELECTRIC COMPANY, Baltimore, Md., has been incorporated as successor to the Wenstrom Consolidated Dynamo and Motor Company. The land and factory at Calverton, Md., with all the franchises, patents, machinery and water rights formerly belonging to the old company, and which were recently purchased at public auction by its bondholders, will be now transferred to the new corporation which will own them free from all debts or liens. The directors named for the first year are: Joseph P. Smith, Enoch Pratt, Jacob Tome, Robert Rennert, John M. Denison, Elihu E. Jackson and G. M. Hutton. The capital stock is fixed at $1,000,000, divided into 20,000 shares of $50 each. The purposes of the corporation are stated to be the manufacture and sale of electrical machinery and supplies, the generation and supply of electricity for light and power, the erection and maintenance of poles and wires and laying of conduits in Baltimore and elsewhere for the conduct and supply of electricity, and the transaction of any business in which electricity over and through wires is applied to any useful purpose. The president of the new company will be Mr. Joseph P. Smith, who was for many years associated with the Fort Wayne Electric Company, and who has organized and managed other large electrical plants. For the past year he has had charge of the construction and management of the Lake Roland Elevated Railway Company, and resigns from that company to accept his new office. The factory will be in operation within 30 days, and will put upon the market a street railway motor, in competition with the best types now in use. The officials state that they are advised that at least two of the electric manufacturing companies are infringing their patents, and that steps will be taken to protect their interests in this direction in due time.

NEW INCORPORATIONS.

THE WEST CHICAGO LIGHT AND POWER COMPANY, Chicago, Ill., capital stock $60,000, has been formed to operate a light, heat and power plant. F. T. Barber, G. E. Walter and C. J. Bussie are the incorporators.

THE MOUNT PLEASANT GAS AND ELECTRIC LIGHT COMPANY, Mount Pleasant, Ia., capital stock $72,000, has been formed to operate a light and power plant in that city. Henry Ambler, G. H. Spahr and H. E. Snider, of Mount Pleasant are the promoters.

THE DES MOINES RAPIDS POWER COMPANY, Hamilton, Ill., capital stock $500, has been formed to erect and operate water power plants, street railways and electric plants. L. W. Cass, 710 Chamber of Commerce Building, Chicago, Ill., and Jas. Anthony and C. B. Holmes are interested.

THE SACRAMENTO COUNTY IRRIGATION COMPANY, San Francisco, Cal., capital stock $1,000,000, has been incorporated to generate and deal in electricity, etc. J. A. Merrill, A. R. Dow, Oakland; R. W. Button, D. R. Thomas and W. B. Thomas, San Francisco, Cal., are the organizers.

THE JUNCTION CITY ELECTRIC LIGHT, POWER AND MILLING COMPANY, Junction City, Kan., capital stock $150,000, has been formed to furnish electricity for light, heat and power, etc. The incorporators are J. K. Wright, A. L. Barnes, Junction City, and J. S. Gibson, Kansas City, Kan.

THE COLUMBIAN GOLD MINING COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to deal in and operate electric light and power plants, etc. The promoters are J. A. Merrill, A. R. Dow, Oakland; D. R. Thomas, R. W. Button and W. B. Thomas, San Francisco, Cal.

THE CALIFORNIA MUTUAL INVESTMENT COMPANY, Los Angeles, Cal., capital stock $200,000, has been formed to deal in real property, and to furnish electric light and power, etc. The parties interested are T. K. Wilson, S. A. Butler, William Adams, W. A. Elderkin and A. M. Anthony, Los Angeles, Cal.

THE DOMESTIC ELECTRIC POWER AND LIGHT COMPANY, Baltimore, Md., capital stock $50,000, has been formed to manufacture and sell the Hanson primary battery and to sell all sorts of electrical appliances. S. Kimberly, J. H. T. Jerome, A. B. Howard, Jr., J. C. Powell and G. H. Dobson are the promoters.

THE GLADSTONE ELECTRIC LIGHTING AND POWER COMPANY, Gladstone, Minn., capital stock $50,000, has been formed to generate and use electricity for light, heat and power, to sell same and deal in all kinds of material. J. W. Kendricks, John Woods, Minneapolis; E. C. Tice, Gladstone, and R. H. Reif, St. Paul, Minn., are interested.

THE PROGRESSIVE POWER COMPANY, Jersey City, N. J., capital stock $300,000, has been formed to construct, etc., engines, boilers, receivers, machines, appliances, etc., for the production of light, heat and power. The promoters are J. H. Batt, Montclair, N. J.; W. K. Lothrop, F. G. Wheeler, E. F. Leeds and J. P. Lowrey, New York City.

THE LEWIS ELECTRIC COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture, use and distribute electricity for the purpose of light, heat and power, etc. I. N. Lewis, Fort Wadsworth, S. I.; V. H. Bridgman, Fort Schuyler, N. Y.; W. S. Fanshawe, Westchester, N. Y., and H. E. Fanshawe, Morristown, N. J., are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 9, 1893.

THE RUMOR of an electric line from Jersey City to Philadelphia is again revived.

MR. FRANK A. MAGEE, representing The E. S. Greeley & Co., of New York, has returned from a successful business trip through the West.

MR. F. R. CHINNOCK, 18 Cortlandt street, New York, sales agent for the Ball Engine Company, of Erie, Pa., has returned from a short trip to Chicago.

THE GENETT AIR BRAKE COMPANY, 33 Wall street, will give a public exhibition of the operation of their air brake as applied to cable cars on the Third Avenue Railroad, on Monday, Oct. 9.

ENGINEER MARTIN, according to the "Tribune," is in Chicago studying the motive power of the Intramural railway with a view to recommending that the same system be used on the Brooklyn Bridge.

THE FITCH EXCELSIOR SWITCH COMPANY, 45 Broadway, informs us that they are about to place another switch on the market, making three switches in all they now have for electric railways.

CHAS. A. SCHIEREN & CO. are building a tannery at Bristol, Tenn., the capacity of which will be 50,000 hides a year. They will there tan oak hides for belting, that being in the midst of a superior bark region.

MR. W. F. D. CRANE, manager of the electrical department of the H. W. Johns Manufacturing Company, will leave for Chicago Wednesday en route to the street railway convention at Milwaukee, where the Johns company have an exhibit.

MR. HENRY G. ISSERTEL has started on a two months' trip through western Pennsylvania, Ohio and northwestern New York, and, among other things, will sell the trolley line insulating materials of the H. W. Johns Manufacturing Company.

L. J. O'REILLY, for years secretary and general manager of Alexander, Barney & Chapin, has opened a new electrical supply house at No. 22 Cortlandt street. He is also interested in the electric fixture and construction business of the Dale Manufacturing Company at the same address.

MR. J. H. VAIL, president of the Electrical and Mechanical Engineering and Trading Company, 44 Broad street, is now in Caracas, Venezuela, on a business trip. He arrived there Oct. 2, and will return the latter part of this month. Mr. Vail stopped at Curacoa and transacted some important business for the company.

MR. WM. A. COURTLAND, formerly of Temple Court, New York, now at 87 Nassau street, is well and favorably known among the electrical fraternity for his excellence in Patent Office drawings. Mr. Courtland has but lately finished drawings for Nikola Tesla, Prof. Crocker and Lieut. Patten, and other well-known electricians.

THE AMERICAN UNIVERSAL ELECTRIC COMPANY, formerly the Wright Universal Electric Company, has removed its office from 126 Liberty street to 140 Washington street, corner of Cedar, where the factory of the company is situated. Vice-President Taylor says orders have been coming in satisfactorily, especially from out of town.

MR. P. C. ACKERMANN, New York representative of the American Electrical Works, has returned from a trip of several weeks West, during which he was in Rochester, Cleveland, Cincinnati, Chicago and Pittsburgh. He states that the business situation is improving, although there is as yet a lack of confidence exhibited by some firms.

HUGO REISINGER, 38 Beaver street, has taken the sole agency for the United States of the "Electra" carbons, manufactured by the Nuernberger Beleuchtungs Kohlen Fabrik, Doos-Nuernberg, Germany. These carbons are for arc lighting on low potential direct, alternating and rotary currents. Mr. Reisinger is prepared to execute orders for ordinary sizes on short notice and will send samples for special tests. Mr. J. C. A. Sutor represents the importer among the trade.

PROF. GEORGE FORBES, the eminent English consulting electrical engineer, whose head offices are 34 Great George steet, London, has opened permanent offices in the Mills Building, Wall and Broad streets, New York. Mr. Horatio A. Foster, late of "Electrical Industries," will be his chief assistant. The intimate knowledge of the electrical industries of the United States possessed by Mr. Foster through his recent connection with the Census Office will be of eminent value in his new position, and the combination is one which we venture to predict will enjoy a great measure of success.

PROF. H. VON HELMHOLTZ was gracefully entertained on Friday afternoon by the officials of the Long Distance Telephone Company, at their rooms at 18 Cortlandt street. A number of interesting experiments were made over the long distance lines, showing the complete success with which the system at present works. A receiver was suspended in the centre of the room and music could be distinctly heard over the line from Boston and back, a distance of about 500 miles, while the conversation from the Chicago end of the line was very loud and clear, and could be readily understood by all those present. Prof. Helmholtz was deeply interested and conversed with Prof. Langley in Washington, and with others in Boston and Chicago. He was accompanied by Prof. Knapp and a few other friends.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 7, 1893.

MR. J. BRADFORD SARGENT, New England agent for the Stirling Boiler Company, has recently sold 100 h. p. of boilers to be shipped to Salem, Mass.

THE CROSBY STEAM GAGE AND VALVE COMPANY, of Boston, Mass., has a very handsome display at the Chicago Fair. Visitors interested in this line of goods will find that an inspection will well repay them.

MR. N. T. GREENE, of Providence, R. I., the inventor of the Greene engine, has associated himself with the California Engineering Company, who have acquired all the rights, title and interest of the Greene engine for the entire United States.

SIR EDWARD GREENE, wife and son, have been registered at the Vendome, Boston. Sir Edward is the inventor of the Greene fuel economizer, and he has within the last year established works in this country at Mattewan, N. Y. He expressed himself as being well satisfied with the business that he has done, and mentioned the fact that there were now a great number of orders on hand.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 MONADNOCK BUILDING, CHICAGO, Oct. 6, 1893.

A. KLIPSTEIN has opened a branch office at 124 Michigan street, Chicago, under the direction of Mr. J. L. Norton, who will carry a stock of the well known Electric Brand of sal ammoniac.

SEALED PROPASALS will be received to noon, Oct. 13, at the office of the Commissioners of Lincoln Park, Ashland Block, for the various material to be used in the construction of an electric lighting plant, as follows: Boilers, shafting, dynamos, wires, pipes and posts, according to plans and specifications, which may be seen at the office of W. D. Ball, Room 110, 113 Dearborn street, Chicago, Ill. G. W. Weber, secretary.

MR. VIRGIL H. HEWES, engineer of the Waddell-Entz Company, has gone to Omaha to install two 40 kw. motors, with 400 Waddell-Entz copper and steel storage batteries, for operating the Interstate swing bridge at East Omaha, Neb. This plant will be quite novel from the fact that current will be taken from the street car lines to charge the storage batteries for use when the street car service is broken. The Interstate bridge is one of the largest swing bridges in the world.

OREGON CITY, Ore., Sept. 25, 1893.

L. F. COOK, of Tacoma, has placed a working model of his elevated single rail electric railway in the Transportation Building at the Chicago World's Fair. It is reported that a stock company has been formed in Chicago with a capitalization of $250,000, which will construct a short line to thoroughly test the system.

THE TACOMA CITY LIGHT AND WATER PLANT, now operated under control of the board of public works, will pay the following as salaries: Superintendent, $1,920 a year. Monthly salaries: Foreman of machinery, $125; electrician, $125, general foreman, $90; day dynamo operator, $95; night ditto, $75; linemen, $75; night inspector, $75; trimmers, $60; night oiler, $50; lamp repairer, $80; night and day engineers, $90; head fireman, $75; firemen, $65.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Sept. 27, 1893.

THE MANCHESTER MUNICIPAL ELECTRIC POWER STATION.—Up to the present this station has been running on the two-wire low pressure system, although the mains have been laid over the city on the five-wire system. As the load is now too large for this practice to be continued, the whole of the lamps were last Saturday removed from the mains, and the plant was rearranged on the five-wire system, many of the lamps being replaced on the new system by Sunday evening. In future the load will be divided into four sections, on the five-wire system. At present there are 10,000 lamps, but it is expected that before long the number will be increased to 30,000.

LIGHTHOUSE COMMUNICATION.—The work of telephonically connecting our shore lighthouses with the postal telegraph system of the country, the money for which was voted by Parliament last year, has been completed, and the work of connecting up the outlying lighthouses and lightships is being proceeded with. It was proposed at one time to connect the Fastnet Lighthouse, off the coast of Ireland, with the mainland by means of a "discontinuous cable." For the present, however, this idea has been abandoned. Should an attempt, however, be made to run a "continuous cable" to this point at any future time, it will probably not be long before it becomes a "discontinuous cable," and perhaps by then Mr. Preece and other investigators will have got beyond the fog of theory and will be able to take advantage of this opportunity to put some of their nebulous ideas to actual test.

THE BRITISH ASSOCIATION AT NOTTINGHAM.—This year the British association met at Nottingham. There was a very poor attendance, only 1,660 members being present. The engineering and electrical work of the Association did not contribute much to the advancement of science, being principally a resume of well known engineering work. Mr. W. W. Beaumont described a practical form of variable power gear for electromotors for traction work, which was well received. A discussion on the utilization of water power took place, and it was shown that English mill sites do not compare favorably with those in America and other countries as a whole, but that under favorable conditions water power can be obtained much more cheaply than fuel power, even at the present prices of coal. A valuable report was made by Prof. Hele-Shaw on graphical methods, which was an extension of the elaborate report made last year. In the mechanical section a useful paper was read by Dr. C. A. Kohn on the application of electrolysis to qualitative analysis, the purpose of which was to show that electrolysis might be used in the detection of metallic and other poisons as a final and crucial test. The work of the physical section was chiefly of theoretical interest, although a practical form of air pump was described in the last meeting by Prof. J. J. Thompson, F. R. S. This section was mostly concerned with questions as to the nature of the ether and its relation to electrical phenomena

News of the Week.

ELECTRIC LIGHT AND POWER.

OSGOOD, IND., is to have electric lights.

POMONA, CAL.—The electric lighting question is being discussed by the Council.

WINDSOR LOCKS, CONN.—The electric light company has voted to take definite steps to improve its plant.

BELCHERVILLE, TEX.—A movement has been started looking to the establishment of an electric light plant.

MONTREAL, QUE.—The City Council has voted in favor of calling for bids for lighting the city with electricity.

ORANGE, TEX.—The Orange Light and Water-Works Com-

pany has issued $10,000 in bonds for the purpose of improving its plant.

MILLEDGEVILLE, GA.—Proposals will be received until Oct. 17 for lighting the city for a period of six years. P. L. Fair is city clerk.

SUFFERN, ROCKLAND COUNTY, N. Y.—J. I. Traphagan is circulating a petition to raise funds to light the town by electricity.

JACKSONVILLE, FLA.—An ordinance is before the Council to provide for the issue of $75,000 in bonds for the erection of an electric light plant.

WASHINGTON, D. C.—Congress is now considering the bill to appropriate $1,000,000 for a public electric lighting plant for the city of Washington.

WASHINGTON, D. C.—Charles B. Road, Doorkeeper of the Senate, is in charge of the matter of the proposed electric lighting plant for the Senate.

YOUNGSTOWN, O.—The citizens will vote at the November election on the question of issuing $100,000 in bonds to establish an electric lighting plant.

WEST FARMS, N. Y.—The Bronx Company, of West Farms, has a contract to furnish electric lighting for the Town of West Chester, plant to be ready Nov. 1.

WILBUR, PA.—Symmes B. Hutchinson, solicitor of the borough, has prepared the form of contract for proposed electric lighting of the streets of the borough.

BELOIT, WIS.—The Electric Light and Power Company's plant at Beloit, Wis., which has been in the hands of a receiver, has been purchased by G. L. Cole, of Fort Atkinson.

NATCHEZ, MISS.—Equipment will be purchased for an arc and incandescent electric light system, by the recently incorporated Natchez Light, Power and Transit Company.

GOSHEN, IND.—The Indiana Light and Power Company has gone into the hands of a receiver. The company was building the Goshen City electric road, extending from Goshen to Elkhart.

TAMPA, FLA.—The Committee on Electricity recommended that the city clerk advertise for bids for electric lighting. George T. Chamberlain is chairman of Committee on Electricity.

LAWRENCE, MASS.—The aldermen have been discussing the question of installing a municipal lighting plant in Lawrence, and have turned the matter over to a special committee, including the mayor.

WILMINGTON, DEL.—The Trustees of the Poor of New Castle County appointed a committee to report on a proposed electric lighting plant consisting of Allan Smith, Delaware Clark and Frank E. Herbert.

NORTHAMPTON, MASS.—Plans have been made for the proposed new plant of the electric company, to be located on Mill River, on West street, but owing to the close money market it will not likely be erected until spring.

SUNCOOK, N. H.—The selectmen have been authorized to enter into a contract for electric lighting for the streets. The Garvin Falls company has put in a plant and it is likely that the plant will be extended and used for this purpose.

NEWTON, MASS.—Prof. C. C. Bragdon, of Lasell Seminary, has applied to the City Council for permission to set up and operate one 15-h. p. and one 25-h. p. engine, it being his intention to light the seminary with electricity from his own plant.

BERKLEY, VA.—The Berkley & South Norfolk Electric Light and Water Supply Company has reorganized, and they will issue $150,000 in bonds to enable them to push the work on their proposed plants here to completion. Edward F. Partridge is president.

BOISE, IDAHO.—At a session of the City Council held Sept. 25 a movement was started which may either result in the city purchasing and maintaining an electric light plant or the organization of a rival company to the one now supplying lights to the city.

LOS ANGELES, CAL.—The Electric Light Committee of the City Council met and decided to pursue investigations as to the practicability of reducing the expense of lighting the city by issuing bonds and erecting an electric light plant, to be owned by the municipality.

TOPEKA, KAN.—Proposals will be received by the Chicago-Topeka Light, Heat and Power Company until noon of Oct. 18 for the construction of a water power and electric plant on the Kansas River at Topeka, Kan. The office of the company is "The Rookery," Chicago.

WOODLAND, CAL.—Recent reports from this place state that the waters of Cache Creek, the outlet of Clear Lake, near Woodland, will be utilized for electric power, as it has been found that more than sufficient power can be developed for manufacturing, street railway purposes, etc.

SOUTH NORWALK, CONN., has the only municipal plant in the State, and the report of the commissioners, one of whom is Mr. A. E. Winchester, the well known consulting engineer, is expected to show very gratifying results at the close of the year. The commissioners have decided to adopt commercial lighting in connection with the municipal business.

PROVINCETON, MASS.—Representatives from an electric light company have been in town conferring with prominent men as to the advisability of establishing an electric light plant here, to supply also the power for a street railway line. The project calls for an outlay of $75,000, and the electric company will invest $40,000 if residents will subscribe the balance.

PLAIN CITY, O.—Sealed proposals will be received at the office of the Village Clerk, of Plain City, O., for the construction of a complete system of water-works and electric light plants, according to the plans and specifications on file in the office of the said village clerk. All bids must be filed by Oct. 20. Bidders are requested to use the printed forms furnished by the city clerk, as no other will be received.

THE ELECTRIC RAILWAY.

BATAVIA, N. Y.—Engineers, under the direction of Hon. J. W. Holmes, of Batavia, are now surveying for an electric road to Depew.

BATTLE CREEK, MICH.—The Battle Creek Electric Railway Company, it is stated, will put in an entirely new equipment on its lines.

LANCASTER, PA.—The engineers, under the direction of Col. S. C. Slaymaker, are now surveying for the proposed line from Lancaster to Reading.

DETROIT, MICH.—A company has been organized to build an electric road to Monroe, with the intention to extend it ultimately to Toledo, O.

COVINGTON, KY.—Sealed proposals will be received until Oct. 11 for the construction of an electric road on Douglass and Davis streets. Joseph Ryan is city clerk.

BOONSBORO, MD.—A company has been incorporated to build an electric railway between Boonsboro and Keedysville, in Washington County, and to illuminate both towns.

CARLISLE, PA.—Promoters of an electric line have succeeded in disposing of stock to the value of $55,000 in New York, and it is expected that work will begin at once.

PRINCE FREDERICKTOWN, CALVERT COUNTY, MD.—A representative of the Baltimore & Drum Point Railroad Company is obtaining renewal of the right of way for the road.

HARTFORD, CONN.—The Common Council has voted by 9 to 8 to postpone indefinitely the resolution giving the Hartford Street Railway Company power to equip with electricity by the trolley system.

WENHAM, MASS.—An extension of time has been granted to the Lynn & Boston Railway by the selectmen for putting in the trolley system to Wenham, and over the Beverly and Danvers branches. Both branches will be in running order by July 1, 1894.

BUFFALO, N. Y.—The Buffalo, North Towanda & Sanborn Electric Railway Company will begin work at once on their proposed road. L. F. W. Arend is president, and Lee R. Sanborn, of Sanborn, secretary. A power house will be built near Bergholtz.

KINGSTON, N. Y.—The Colonial Railway Company will commence building its road at once. The motors to be used will be those of the United Columbian Electric (Winkler) Company, of Kingston, and the trucks for the cars will come from the Peckham works.

NEW HAVEN, CONN.—The New Haven Street Railway Company has secured control of the State Street & Morris Cove Railway, in pursuance of its purpose to consolidate the local street railway systems. The president is David Corey, of New Haven; secretary, treasurer and general manager, G. A. W. Dodge, of New Haven.

HAVERHILL, MASS.—The Shaw & Ferguson Railway interests have withdrawn from the New England combine, which proposed to operate a system of electric roads between the cities of Maine, New Hampshire and Massachusetts. It is stated that a new combine will be formed by Mr. Ferguson on much the same plan as the old, but to cover a smaller territory.

ADRIAN, MICH.—Samuel D. Nesmith, the proprietor of the proposed electric line between Adrian and Ypsilanti, will have control of the Adrian electric road after October 1. The line will be extended through several cities, making 42 miles of new track necessary. It is reported that the work will soon be commenced in several places. Power houses will be stationed at Tecumseh, Saline, Ypsilanti and Adrian.

THE SACRAMENTO ELECTRIC POWER AND LIGHT COMPANY, Sacramento, Cal., has purchased the street railway system of the Central Electric Railway, and possession will be taken Feb. 1, 1894. The road is 16 miles in length, and additions will be made. The whole will be operated by power transmitted from the station of the Folsom Water Power Company, at Folsom, which will also supply current for lighting and power to Sacramento from the same water power plant.

WATERBURY, CONN.—Secretary A. M. Young, of the Waterbury Traction Company, stated to a reporter of the Waterbury "American" that an agreement having been reached with the Common Council the work of developing and extending and equipping the line with electricity will be pushed as fast as possible. Contractors are now going over the specifications for the extension of the line from Simonsville to Naugatuck. This part of the work will be done first, and as soon as the contracts can be made.

MYERSVILLE, MD.—The stockholders of the Catoctin Valley Electric Railroad and Power Company have elected George W. Jacobs, Jr., of Philadelphia, as president; C. F. Flook, of Myersville, as secretary; and G. W. Wachtel, of Myersville, as treasurer; and they propose to operate an electric road from Middletown, via Myersville, to a point in the northern part of Middletown Valley, about 12 miles, to run in connection with the Frederick & Middletown Railroad. The contract for the building of the road has been awarded to the Hughes & Rigby Company, of Baltimore, Md.

POWER STATION DATA.—The results that can be accomplished in the power stations of the smaller electric railways is well illustrated by the following data from the power house of the Terre Haute Street Railway Company, Terre Haute, Ind.: The station has a Westinghouse equipment throughout, both in engines and generators, there being one compound non-condensing engine, 330 h. p., and two of 130 h. p. bolted to the generators. The log of this station is carefully kept, and as it runs quite uniformly from day to day, the record of a single day is abstracted as a fair average: Total hours run, operating cars, 17¼; total engine hours run, 18; maximum number of cars running: 13 cars each having one 15-h. p. double reduction motor; 2 cars each having two 15-h. p. double reduction motor; making 22 cars and 24 motors. There were also 7 trailers. Boilers running, two 54 by 16-inch, 60-h. p. each; engines running, one 18 to 30 by 16-inch Westinghouse compound; steam pressure, 110 pounds; amperes, 95 to 350; voltage, 500; car mileage, 1,940; coal, bituminous slack (poor quality, evaporation about 4 to 11); cost of coal per ton delivered, 90 cents; coal used in 18 hours, including banking, 11 tons; cost of coal per car mile, .51 of a cent. A note on the report of this day shows that the weather was hot and dusty, and that the cars pulled hard. Also that the circuit breaker opened an unusual number of times on account of heavy load. The ampere readings on the record sheet, while indicating occasionally heavy loads, frequently ran quite low, showing that the service was subject to very wide fluctuations, as would be expected with a plant of this size.

LEGAL NOTES.

ELECTRIC LAMP LITIGATION.—Injunction proceedings are in progress at Philadelphia and York, Pa., instituted by Edison licensees against Westinghouse lighting companies.

A FINAL DECREE has been entered by Judge Grosscup in each of the suits brought by the Edison Electric Light Company, of Chicago, against the Illinois Electric Lamp Company and the Sunbeam Incandescent Lamp Company for an injunction and accounting. The decree in each case establishes the validity of the patent granted Thomas A. Edison in January, 1880, for the improvement of electric lamps. It further gives the complainant nominal damages and a perpetual injunction. Defendants were makers and users of incandescent lamps, which the complainant corporation claimed were in infringement of the Edison patent. In reply to the bill filed by the Edison interests the defendants filed answer calling in question the validity of the Edison patent and citing a number of authorities to show that it had been anticipated elsewhere.

PERSONAL NOTES.

PROF. HERMAN VON HELMHOLTZ sailed for Europe on the "Saale" Oct. 7.

GEORGE H. SEEVER has been appointed instructor in electrical engineering at Columbia College.

DR. FREDERICK BEDELL has been promoted from instructor to an assistant professorship in physics at Cornell University.

MR. STORY B. LADD has succeeded to the business of Paine & Ladd, patent lawyers and solicitors, Loan and Trust Building, Washington, D. C.

MISCELLANEOUS NOTES.

WALLACE & SON'S rolling mills, at Ansonia, Conn., are now running full force under the receivers.

THE SEMINARY IN NORTH GRANVILLE, N. Y., has departments for telegraphy and electrical work.

LARGE TURBINES.—Three of the 5,000-h. p. turbines for the Niagara Falls Company are finished and are reported to cost $200,000 each.

TROLLEY STEAMSHIPS.—The Boston "Courier" believes in the possibility of ocean steamers being propelled by electricity from submarine trolley lines!

A LAMP WITH A RECORD.—The electrician of an isolated plant in operation at Smith's Hygienic Institute, Geneva, N. Y., in a recent communication to The Electrical World, states that a Swan lamp has been in constant use for four hours each day since Dec. 15, 1885.

A NEW LONG DISTANCE TELEPHONE LINE.—The last connection was made on Oct. 2 on the long distance telephone between Spokane, Portland and Willamette points, Tacoma, Seattle and Puget Sound points, thus completing the second longest telephone line in the world, the main line being 750 miles long.

HELMHOLTZ AND BELL.—Prof. A. Graham Bell said to a New York reporter: "Prof. Helmholtz was the foremost man in discovering the principle of transmission of sound as exemplified in our modern telephone. When I became interested in telephony I followed the line of Prof. Helmholtz's researches, and on the result of his work as a basis I built my inventions."

A SOUTH AMERICAN PROJECT.—From "El Comercio," of Cochabamba, Bolivia, we learn that the South American Exploration, Development and Colonization Company, authorized by an act of the United States Congress, July 23, 1892, has, through F. W. Grauert, made a proposition to the Bolivian government asking for certain grants of land with a view to the development of the same, and electricity is named as one of the agents to be utilized.

REMARKABLE HUSTLING.—The Newark & South Orange Railroad Company equipped and ran its first car to South Orange by electricity on Oct. 6, scarcely 12 hours after the South Orange board of trustees had unanimously passed an ordinance granting it that privilege. There was a rumor that village authorities were to get out an injunction to prevent the running of the cars, so the railroad people put a gang of 300 men to work the night of Oct. 5, as soon as the ordinance passed. Poles were erected, wires strung and electricity turned on at 10:40 o'clock the next morning, when the first car was run to the South Orange terminus.

THE FOLSOM-SACRAMENTO TRANSMISSION PLANT.—The Sacramento Electric Light and Power Company is about to install a plant for the generation of electric power and its transmission to Sacramento City, 18 miles distant. The first installation will deal with about one-fourth of the power which the Folsom Canal will afford, and will consist of four pairs of horizontal cylinder gate turbine wheels, set so as to utilize 55 feet of the fall, producing about 1,300 h. p. each pair. To the shaft of each pair of wheels will be bolted an electric generator of 1,000 h. p. capacity. One pair of wheels and one electric generator will always be held as a reserve, so that 3,000 h. p. net will be transmitted to Sacramento. The transmission plant will be an overhead pole line of bare wires, and the contract for installation will guarantee a net available efficiency delivered at the receiving station in Sacramento of upward of 78 per cent. of the power of the turbine shafts. The receiving station in Sacramento will be fitted so as to operate a complete street car system for the city and suburbs, furnish lights, both arc and incandescent; also furnish motive power for all descriptions of manufacturing. There already exists in Sacramento a requirement for power in the above uses fully as great as the capacity of this "Transmission Plant No. 1," and as soon as the capacity of "Plant No. 1" is absorbed it will be followed by "Transmission Plant No. 2," of equal capacity. The contract for "Plant No. 1," which is now being concluded, stipulates that it shall be operative by Feb. 1, 1894.

Trade and Industrial Notes.

THE W. P. LITTLE COMPANY, Buffalo, secured the contract for the incandescent light plant for the Binghamton Hospital.

HINE & ROBERTSON, 57 Cortlandt street, report sales of Wainwright heaters for the past two months larger than any previous months in the year, and a large proportion of the sales were to electric light and railway companies.

THE DALE COMPANY, 22 Cortlandt street, New York, has just completed an installation of 500 lights for the large jewelry house of S. F. Myers & Co., New York, and have undor way the lighting of one of the large steamers of the "Old Dominion" line, and an extensive tannery building at Newtown, L. I.

W. R. BRIXEY is one of the fortunate prize winners at the World's Fair competition, having received an award for each of the prominent varieties of the time honored and always reliable Day's Kerite. Awards were given for Day's underground, aerial, submarine, telegraph and telephone cables.

CHAS. A. SCHIEREN & CO., 45 Fery street, New York, are now making a 72-inch 3-ply perforated electric belt, a duplicate of one made for the same firm. They are also making similar belts of 32, 36, 40 and 48 inches. The demand for perforations is increasing, especially in wide driving belts.

H. W. JOHNS MANUFACTURING COMPANY, 87 Maiden Lane, New York, has issued a pamphlet entitled "Insulation," which deals with the various insulating materials manufactured by this enterprising company, including molded mica, vulcabeston, asbestos and "Monarch" insulating material.

AWARDS AT THE WORLD'S FAIR.—In the list of awards given in The Electrical World last week mention was made of I. P. Fink, New York. This was a typographical error, and the many friends of this well known firm doubtless recognized the name and saw that it should have been I. P. Frink.

THE WAINWRIGHT MANUFACTURING COMPANY, No. 8 Oliver street, Boston, Mass., has just published its latest catalogue, which contains drawings and important information concerning heaters, condensers and expansion joints. This book will be found useful by street railway and electric light station managers.

MESSRS. M'LEOD, WARD & CO., 91 Liberty street, New York, have just finished wiring the seven story building 13, 15, 17 West Thirteenth street, New York City, owned by Mr. F. W. Kieley and occupied by Messrs. Butterick & Company. Messrs. McLeod, Ward & Co. also placed on the ground floor seven of the latest improved Ward arc lamps.

J. HOLT GATES, Western manager of the Waddell-Entz Company, Monadnock Block, Chicago, Ill., reports the sale of three large direct connected machines to the West Chicago Street Railway Tunnel Company. The Waddell-Entz Company is also installing two large motors with 200 Waddell-Entz copper and steel storage batteries at the Sioux City, Ia., swing bridge.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., has recently brought out a new device called the Eichberg patent tree insulator, which is intended to overcome the trouble caused by the destruction of insulation on line wire from constant rubbing against the branches of trees. The insulator perfectly insulates the line and gives it plenty of play when attached to the branch, permitting it to move in any direction with the swaying of the limb.

QUEEN & COMPANY, INCORPORATED, Philadelphia, have recently received large additional orders from the Armour Institute of Chicago for instruments to be supplied from their World's Fair exhibits. This is very gratifying to them, for Prof. Stine is a most critical buyer and insists upon equipping his laboratory with the best apparatus. Substantial orders from other large colleges have also resulted in consequence of the Exposition, where their display is certainly one of the finest to be seen.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY'S plant at Watsessing, near East Orange, N. J., is fast nearing completion. The main factory is 250 by 100 feet in size and the power house is 50 by 100 feet. The structure is solid brick and the interior is all of heavy iron. It is two stories high and will contain over 200 windows. The factory will be one large room, the front being divided into offices. The building will be ready for occupancy about Dec. 15, and it is said 400 hands will be employed.

THE SHAWMUT FUSE WIRE COMPANY, 161 High street, Boston, sends us a copy of its new catalogue on "Tested Fuse Wire and Fuse Links" which contains considerable technical information of a general nature on electric fuses. Several curves are included, showing the variation of the diameter with the fusing point, the time required for fusing and the variation of the fusing point with the length of the fuse. The matter from the pamphlet on "Fuse Wires and Its Uses" is incorporated into the catalogue.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, report that they have experienced a considerable revival of business during the past two or three weeks, having received orders in this time for the following size machines, in addition to a considerable number of smaller sizes: One 30-kw. machine, Graham Hotel, New York City; one 25-kw., Gardner Building, Toledo; one 25-kw., Toledo Water-Works, Toledo, O.; one 15-kw., Troy, N. Y. They believe the trade prospects are growing brighter daily and expect a good volume of business during the fall and early winter.

THE MOUNT WASHINGTON GLASS COMPANY, New Bedford, Mass., has recently put a new reflector on the market known as the "Columbia." The new shades are made in a beautiful translucent opal glass, with finely decorated designs, and also in crystal glass, the bottom frosted and the conical sides silvered. The shade is nine inches in diameter and has a 3¼-inch opening at the top as usual, and in addition a similar one in the bottom, so that a lamp may be entered from below instead of only from above, as in the similar type at present on the market.

THE SLATER ENGINE COMPANY, of Warren, Mass., has erected a handsome brick factory, 234 by 60 feet, with a draughting room 18 by 62, and ample vaults for the storing of important patterns and drawings. It has also built a foundry 50 by 75 feet and a boiler house 30 by 30 feet. The factory is being equipped with all the latest improved machinery, which is furnished by the Prentiss Tool and Supply Company, of New York. The Slater Engine Company will manufacture the Slater-Brown engine, designed by Mr. Frank Slater, who is also president of the company, and who was formerly with the Brown Engine Company, Fitchburg, Mass. It is proposed to build these engines in sizes from 50 to 3,000 h. p.

THE BRUSH ELECTRIC COMPANY report that Mr. C. R. Huntley, of Buffalo, has purchased for the new lighting plant at Niagara Falls, N. Y., one of the No. 8 65-light, 2,000-c. p. arc dynamos comprising the service plant of the Brush company in Machinery Hall, to be delivered at the close of the Exposition. This leaves but one of the 16 dynamos unsold. There will also accompany the dynamos 60 of the double carbon Brush-Adams lamps which are now doing duty on the "all night" circuit at the Fair. The Indianapolis Light and Power Company have placed an additional order for 190 double-carbon lamps, which makes 856 which they have bought within eight months. These taken in conjunction with the 15 65-light dynamos which they have purchased during the same period shows their appreciation of the Brush system.

MR. H. A. REED, of the Bishop Gutta Percha Company, recently received word from Captain Brice, who has charge of the lighthouse district of Chicago, that one of the thirteen lamps on the buoys between the Chicago breakwater and the World's Fair was broken. This is the first time a lamp has failed since the system was put in by the Bishop Gutta Percha Company, which took place on July 2 this year, and the effect was watched with more than common interest, as there is no other system of the kind in existence. The lamps on top of the buoys are 100-c. p. Bernstein incandescent lamps, burning on an any way affect the others, Mr. Reed is highly pleased with the arc current. As the failure of the one broken lamp did not in test the system has been subjected to.

A. L. IDE & SON, Springfield, Ill., report having received during the last ten days the following orders: One 100-h. p. Ideal engine for the Ludington Building, Chicago (second order); one 125-h. p. Ideal engine for the Hoopeston Canning Company, Hoopeston, Ill.; three 175-h. p. Ideal tandem compound engines for the new Stock Exchange building, Chicago; two 125-h. p. and one 100-h. p. Ideal engines for the Southern Hotel, St. Louis. The Stock Exchange and Southern Hotel engines are all to have General Electric Company multipolar armatures directly attached to their crank shafts, the Stock Exchange engines driving 100-kw. machines and the Southern Hotel engines driving 50-kw. machines. The two 125-h. p. engines drive in addition one each 50-arc light dynamo belted from its governor pulley.

W. R. FLEMING & COMPANY, New York and Boston, representatives of the Harrisburg (Pa.) Foundry and Machine Works for Ide and Ideal engines, complete steam plants, etc., report the following recent sales and call attention to the high class of buyers shown: Simple Ideal engine, one 140-h. p., to Elmer & Amend, New York City; one 70-h. p. for Metropolitan Museum of Art, New York City; one 25-h. p. for New Bedford (Mass.) Water-Works; one 50-h. p. for New York Institute for Deaf Mutes; two 60-h. p. for Industrial Trust Company, Providence, R. I.; one 25-h. p. for the New York Equipment Company; one 100-h. p. for General Electric Company; one 50-h. p. for Electrical and Mechanical Engineering and Trading Company; one 50-h. p. Ideal engine, high pressure, Harrisburg boiler and complete steam plant for Adams Express Company, New York City; one 100-h. p. engine, Harrisburg high pressure boiler and complete steam plant, Staunton, Va.; two 350-h. p. tandem compound condensing Ideal engines, Harrisburg high pressure boilers and complete steam plant for electric railway service for New Bedford & Fair Haven Traction Company; three 80-h. p. simple Ideal engines, direct connected with iron-clad General Electric Company's multipolar dynamos for new Falls River steamer Priscilla. Messrs. W. R. Fleming & Company have also several contracts on hand for installation of power transmission machinery with New York and Penn Company; Langville Black and Carbon Company, New York City, and Hackensack Edison Colonial Company. This is a very creditable list considering the depression of the times, which does not seem to have much effect upon either the goods or the people noted.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

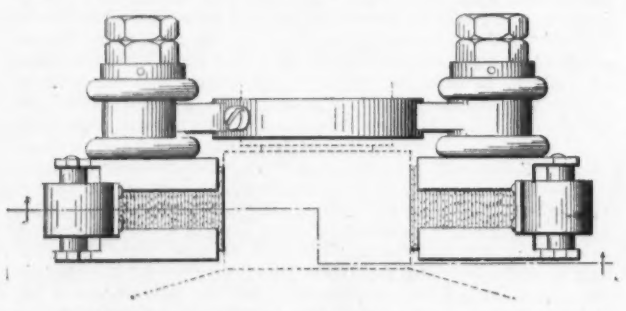
DESK ROOM in the commodious office of The Electrical World, in the new Monadnock Block, Chicago, may be obtained by applying in person or by letter to the office, 936 Monadnock Block.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED SEPT. 26, 1893.

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.

505,457. TROLLEY WIRE SUPPORT; L. T. Gibbs, Milwaukee, Wis. Application filed Oct. 15, 1892. In a trolley wire hanger, the combination of a bolt adapted at its upper end to be connected to a post or equivalent sustaining medium, and provided at its lower end with a disc, of a cylinder surrounding said disc and movable relatively thereto, a cap applied to the top of the cylinder and provided with an opening to receive the bolt, a spiral spring located within the cylinder, the bolt and bearing at its ends respectively on the cap and disc, and an insulated wire clamp applied to the cylinder.



No. 505,665.—DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR.

505,467. SECONDARY BATTERY; I. Kitsee, Philadelphia, Pa. Application filed May 23, 1892. In a multiple cell, an electrode or electrodes, composed of non-conducting material supporting two or more conductors, said conductors having no metallic connection with each other, whereby in use they are electrically connected through the electrolyte only.

505,505. MULTIPHASE MOTOR; L. Bell, Boston, Mass. Application filed June 14, 1893. In an electric motor of the inductive type, the combination wth a revolving secondary member normally close-circuited through a resistance moving therewith, of means for varying said resistance. (See illustration).

505,539. FIELD MAGNET CORE FOR DYNAMOS; G. Strong, New York, N. Y. Application filed Feb. 3, 1892. A field magnet core for dynamos or electric motors consisting of a series of bars bent to a horseshoe form and abutted together so that their bent ends will form poles, in combination with insulating material inserted between the bent ends which form parts of each pole and tie plates outside of the insulating material and extending between the bars of adjoining sets.

505,561. ELECTRICAL CONNECTION; W. I. Smith, Memphis, Tenn. Application filed April 19, 1892. In combination with an electrical conductor having a bared terminal of a contact plate conforming in shape to the portion of the body to which it is applied and provided with projecting threaded studs, a binding plate provided with perforations engaging the studs, a slot at one end and a hook at the other end, binding nuts engaging the studs and binding said binding plate upon the bared terminal of the conductor between the same and said contact plate, a slotted attachment plate, and an elastic band connected with said slotted plate and the slotted end of the binding plate.

505,594. CONTROLLING DEVICE FOR ELECTRIC MOTORS; C. C. Curtis, New York, N. Y. Application filed Oct. 22, 1892. Means for regulating two or more electric motors comprising a switch for connecting them in either series or multiple arc relation, a handle controlling said switch, an independent handle operating a circuit-closing arm, and interlocking connection which prevent the operation of the switch handle except when the circuit is open. (See illustration).

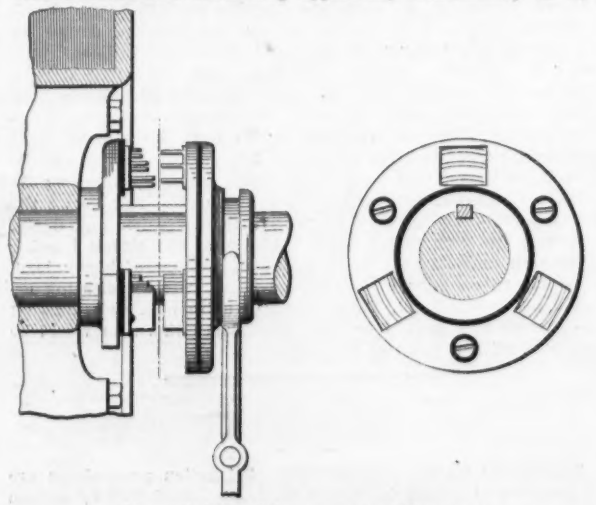
505,605. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; G. W. McNear, Oakland, Cal. Application filed Aug. 1, 1892. In an electric railway, the combination of conduit arms of the yokes, removable slot irons carried by the arms, brackets secured to one side of the conduit arms, and an envelope or sack carried by the brackets and containing the electrical conductor and contact strips, said envelope or sack consisting of an insulating strip or bar with hollowed lower side and the transverse insulating flexible diaphragm secured across the side.

505,622. DYNAMO-ELECTRIC MACHINE; A. S. Atwater, Cleveland, O. Jan. 23, 1893. In a dynamo-electric machine a duplex commutator consisting of duplicate taper sections provided with shaft insulation and separated from one another, in combination with an insulated clamping ring, and radial brushes, adapted to bear upon the ends of said sections.

505,628. DUPLEX TELEPHONY; W. Marshall, New York, N. Y. Application filed Feb. 28, 1892. In a system of electrical transmission, a receiving telephone having two helices oppositely wound, the two helices being in separate branches on the main circuit and one of said branches containing a condenser.

505,665. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; R. Lundell, Brooklyn, N. Y. Application filed Oct. 31, 1892. A brush holding device consisting of a hollow sleeve slitted in the direction of its length, in combination with a detachable spring carrying a follower on one end and having a bearing or support in the sleeve at the other end, the end which carries the follower having movement in the slit as the follower bears against and moves forward with the brush. (See illustration).

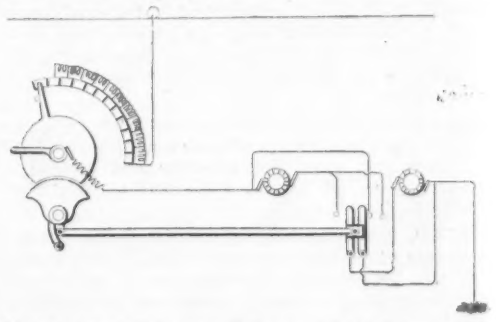
505,669. MEANS FOR PREVENTING RAILROAD COLLISIONS; E. M. DeMonte and C. Jost, Bombay, India. Application filed Oct. 28, 1892. Means for preventing railroad collisions comprising a track composed of individual sections having switches and side tracks at the end of each section, electro-mechanical controlling apparatus, substantially as described, one for each end of a section and arranged so that the mechanism of one apparatus is set in motion by an electric current from the batteries of the apparatus at the other end of the section, a transposing lever arranged alongside the rail at the end of each track section, and adapted to be actuated by the broadened flange of a locomotive or other wheel, means for connecting each lever with the corresponding apparatus, a switch mechanism for operating the said switches and means for connecting the switch mechanism with the corresponding apparatus, substantially as shown and described.



No. 505,505.—MULTIPHASE MOTOR.

505,686. CONTROLLER ROLLER FOR ELECTRIC CARS; E. P. Warner, Chicago, Ill. Application filed June 21, 1892. In a controller roller for electric railway cars, the combination with large and small discs of insulating material placed alternately upon a shaft, of means for clamping the discs upon said shaft, and means for preventing any rotary motion of the discs relatively to said shaft, and conducting strips attached to the peripheries of the larger discs.

505,729. ARMATURE FOR ELECTRIC MOTORS; W. J. Sherwood, Ashtabula, O. Application filed April 16, 1891. In an electric motor, or dynamo, an arrangement consisting of a cylindrical frame provided at suitable intervals with outer and inner bars of insulating material and outer and inner insulating linings arranged upon the outer and inner faces of the cylindrical frame between the bars, the latter being provided with substantially radial grooves, which communicate



No. 505,594.—CONTROLLING DEVICE FOR ELECTRIC MOTORS.

with slots formed in circumferential lines in the linings, said grooves and slots forming continuous air passages around the coils of the armature.

505,730. TELEPHONE CIRCUIT; T. Spencer, Cambridge, Mass. Application filed Feb. 20, 1893. The combination of a main telephone circuit; a supply current generator included therein; a current varting transmitter included in the circuit at a station thereof; an induction coil therefor, having its primary helix in a branch forming a shunt circuit round the transmitter and its secondary helix in a like branch forming a shunt round the primary, both of the shunts or branches being of high resistance relatively to the transmitter, whereby the major part of the normal current is directed through the transmitter; and means for preventing the undulations of the main current produced by the operation of the transmitter from propagating themselves over the main circuit conductively, and for enabling the transmitter to develop such undulations or voice currents in the main circuit and to act upon receiving telephones included therein, solely through the intermediation of the induction coil.

505,783. ELECTRIC MOTOR; R. Ashley, Philadelphia, Pa. Application filed May 20, 1893. The combination with an armature core having radially projecting equidistant L-shaped teeth, of separate and separately removable coils of insulated wire fitting over the shank or radial body of the tooth and held in place by the lateral overhang of the same.

505,798. MANUFACTURE OF CABLES FOR MULTIPLE SWITCHBOARDS; O. A. Bell, Brooklyn, N. Y. Application filed Nov. 7, 1892. The method of arranging the wires of cables for connecting therewith, which consists in laying bare a portion of the cable to shorten the same and separating the different wires of the cable from the body thereof at different points, respectively; whereby the wires of the cable protrude therefrom at different points along its length.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1876—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.